Nushagak River Salmon Escapement Assessment:

Upper Nushagak and Koktuli Weirs, 2024 Annual Report

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Cover Photos:

Technician sampling a Chinook salmon at the Koktuli weir (left); Koktuli weir after installation (right).

Executive Summary

In 2024, the Bristol Bay Science and Research Institute (BBSRI) successfully installed and operated two fish weirs as part of the Nushagak River Chinook Salmon Assessment Program. These weir projects produced escapement counts and age, sex, length and genetic data for adult Chinook (*Oncorhynchus tshawytscha),* chum (*Oncorhynchus keta*) and sockeye (*Oncorhynchus nerka*) salmon on the Upper Nushagak and Koktuli rivers. These data will provide points of comparison for the Chinook salmon escapement indices generated by the Portage Creek sonar project, operated by the Alaska Department of Fish and Game (ADF&G), and will form the foundation of an independent abundance index for the Nushagak River as the assessment program expands.

In 2022, the Alaska Board of Fisheries listed the Nushagak Chinook salmon as a stock of concern in response to dramatic declines in run sizes observed between 2010 – 2022. Nushagak River Chinook salmon returns have repeatedly failed to meet minimum sustainable escapement goals (SEGs) in the last six years and have proven difficult to comanage with abundant and commercially valuable sockeye salmon stocks. However, the system by which salmon passage in the Nushagak River is estimated, the Portage Creek sonar array, has been demonstrated to be inaccurate and highly variable when estimating passage for both Chinook and sockeye salmon (Data on file with Central Region Research Group, ADF&G, Division of Commercial Fisheries, Soldotna; Maxwell et al. 2020; Nass and Head 2024). Moreover, the SEGs themselves are based on unreliable sonar estimates and, therefore, may not be realistic metrics for Chinook salmon productivity in the Nushagak river system (Head and Hamazaki 2022). The Portage Creek sonar does not appear to be precise enough to inform regulatory decisions in low run years, yet Chinook salmon runs falling marginally below the lower SEG limits have prompted limitations of commercial sockeye salmon fishing opportunities in recent years (ADF&G 2025a; Sands 2023).

These challenges have highlighted the need for additional escapement monitoring efforts in the Nushagak River system, independent from the Portage Creek sonar. BBSRI began the Nushagak River Chinook Salmon Assessment Program in 2024 to provide better Chinook salmon passage data from major tributaries in the Nushagak River system, beginning with the installation of two fish counting weirs on the Upper Nushagak and Koktuli rivers. The program is intended to expand in the coming years, including the addition of mark-recapture and drone survey projects, with the ultimate goal of developing an independent Nushagak River Chinook salmon abundance index.

The Upper Nushagak weir operated from June 29 to August 12, 2024 with no outages, and the Koktuli weir operated from July 6 to August 6 with a seven-day outage from July 14 – 21. Passage counts of Pacific salmon migrating through the weir were conducted daily, and scale, sex, length and tissue samples were collected from Chinook, chum and sockeye salmon. The Upper Nushagak weir was operated for 44 consecutive days, and 2,206 Chinook, 7,259 chum and 1,369 sockeye salmon were counted during passage counts. Technicians sampled 174 (7.9%) of the Chinook, 186 (2.6%) of the chum and 99 (7.2%) of the sockeye salmon. The Koktuli weir operated for 24 days, and 966 Chinook, 5,940 chum and 2,166 sockeye salmon were counted. Eighty-seven (9.0%) of the Chinook, 196 (3.3%) of the chum, and 49 (2.3%) of the sockeye salmon were sampled at the Koktuli weir.

The Nushagak weir projects were funded through a Direct Legislative Grant from the State of Alaska.

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List of Terms

ADF&G Alaska Department of Fish and Game

ASL Age, Sex, Length

BBSRI Bristol Bay Science and Research Institute

DIDSON Sonar Dual Frequency Identification Sonar

GCL Gene Conservation Laboratory

MEFK Mid-Eye to Fork Length

OEGs Optimum Escapement Goals

RMI River Miles

SEGs Sustainable Escapement Goals

Introduction

The Nushagak River, a major tributary of Bristol Bay, hosts one of the largest Chinook salmon (*Oncorhynchus tshawytscha*) runs in Alaska and produces the majority of Chinook salmon returning to the Bristol Bay region (Elison et al. 2024a). The Nushagak District, composed of the Nushagak, Wood and Igushik rivers, has historically supported significant commercial, subsistence and recreational Chinook salmon fisheries, although these fisheries are sustained almost entirely by the Nushagak River Chinook salmon stock. While the Wood and Igushik rivers have their own Chinook salmon populations, they do not represent a significant proportion of the district-wide production compared to that of the Nushagak River and have not been formally assessed.

However, Chinook salmon returns in the Nushagak River have declined dramatically in recent years, demonstrated in 2023 by an estimated district-wide total run size of 50,763 which fell far below the 20-year average of 149,314 (2004 – 2023) (Figure 1; Elison et al. 2024a). Once a thriving directed Chinook salmon commercial fishery, weak returns beginning in the late 2000's prompted increasingly conservative management actions in the Nushagak District as stock productivity continued to fall. While the district still produces the most Chinook salmon of any Bristol Bay region, representing 87.6% of the bay-wide commercial harvest on average between 2004 – 2023, the directed commercial fishery was closed in 2010, closed again in 2014 and has yet to be reopened, thus all commercial Chinook salmon harvest since 2014 has been incidental to the sockeye salmon fishery (ADF&G 2022; Elison et al. 2024a). Of the 19,264 Chinook salmon caught in the Nushagak District in 2023, 30.0% of the harvest was commercial, while 24.8% was from sport fishing and the remaining 45.1% was from subsistence fishing (Elison et al. 2024a).

The Alaska Department of Fish and Game (ADF&G) operates the Bristol Bay salmon fisheries using an escapement-based management system, wherein "sustainable escapement goals" (SEGs) are set for each monitored species in each river. The fisheries are managed so that the number of fish that return to a particular river falls within a given range of upper and lower SEG limits. Sustainable escapement is defined by ADF&G as a level of escapement known to produce a sustained yield over a 5 – 10 year period (ADF&G 2025b). In addition to SEGs, the Nushagak River also has an "inriver goal" for Chinook salmon, set by the Alaska Board of Fisheries, which refers to the quantity of fish that must remain unharvested and travel into the river so that SEGs are met and a certain number of fish are available for inriver harvest.

In the Nushagak River, sockeye (*Oncorhynchus nerka*) and Chinook salmon escapements are monitored throughout the season by a Dual Frequency Identification (DIDSON) sonar array at Portage Creek, which is operated by ADF&G (Figure 2). Sockeye salmon escapements are also monitored by counting towers on the Wood and Igushik rivers, however because the Wood and Igushik river Chinook salmon runs are comparatively negligible in size, the Nushagak River sonar site provides the only index of Chinook salmon escapement in the district. Inseason sonar escapement estimates are supplemented with peak spawning aerial surveys flown over ten sections of the Nushagak drainage, however these only provide a relative index of spawning population sizes and are generally understood to be imprecise. The current SEG range for Nushagak River Chinook salmon is 55,000 – 120,000 with an inriver goal of 95,000, which was increased from a range of 40,000 – 80,000 in 2013 when the old Bendix sonar system was replaced by the more precise DIDSON system (Buck et al 2012; Fair et al. 2012; Section 5 AAC 06.361).

The current management strategy has prioritized minimizing Chinook salmon harvest in the Nushagak District commercial salmon fishery, although various restrictions on sport fishing harvest, gear and access have also been introduced since 1992 (ADF&G 2022). Sockeye salmon escapement “triggers” were instituted for the Wood River in 1992, whereby a certain proportion of the sockeye salmon run must be projected to escape upriver before the commercial fishery is opened during periods of low Chinook salmon abundance (Alaska Board of Fisheries 1992). This mechanism was implemented with the intention of giving Chinook salmon more time to escape upriver before the commercial season begins, however this approach has proven challenging due to the high degree of overlap between the Chinook and sockeye salmon run timings. While Chinook salmon reach the district earlier than sockeye salmon, with the middle 50% of the run typically passing between June 19 – July 3, sockeye salmon migrate into the Nushagak Bay from mid-June to late July, with the middle 50% of the run typically passing between July 1 – July 10 (ADF&G 2022). Consequently, there is often a significant portion of the Chinook salmon run still moving though the fishing district when the sockeye salmon arrive in number, and when the commercial gillnet fishery has historically been opened. As sockeye salmon runs in the Nushagak River have reached unprecedented highs over the last 10 years, setting historical records for total run size in 2018, 33.75 million, and escapement in 2021, 4.69 million, the current strategy of delaying the opening of the fishery has raised concerns regarding sockeye salmon over-escapement and forgone commercial harvest (Elison et al. 2024a; ADF&G 2025a). Conversely, Nushagak River Chinook salmon runs have continued to underperform, failing to meet inriver goals every year from 2019 – 2024 and failing to meet minimum SEGs for five of those six years (Figure 1; ADF&G 2025a).

To protect Chinook salmon productivity, Nushagak District commercial salmon seasons were delayed past the Wood River’s 100,000 sockeye salmon trigger every year except 2018 from 2017 – 2022, and in 2022 the Nushagak River Chinook salmon was recommended to the Alaska Board of Fisheries for listing as a stock of concern (ADF&G 2022). In 2023, the King Salmon Stock of Concern Action Plan was instituted, which raised the sockeye salmon escapement trigger for the Wood River, instituted a trigger for the Nushagak River, and introduced optimum escapement goals (OEGs) (ADF&G 2023; Sands 2023; Section 5 AAC 06.391). Unlike SEGs, OEGs are established by the Alaska Board of Fisheries and incorporate “biological and allocative factors” beyond sustainable yield and therefore may differ from SEGs (ADF&G 2025b). In this instance, during years in which the sockeye salmon run forecast is high (>5 million for the Wood River, >2.5 million for the Nushagak River), the Department will manage to a sockeye salmon OEG that is equivalent to the sum of the upper SEG limit plus 15% of the forecasted run size. In years with lower sockeye salmon run forecasts, the Wood and Nushagak rivers will be managed to the lower halves of their sockeye salmon SEGs, set at 700,000 – 1.8 million and 370,000 – 900,000, respectively. These new guidelines effectively further delay commercial season openings, allowing a larger window of time for Chinook salmon to escape upriver without contending with the commercial gillnet fishery. From 2020 – 2024, the Nushagak District saw the lowest commercial harvests of Chinook salmon on record, although it is difficult to distinguish between the effects of management decisions on

Chinook salmon harvest and the progressive decline of the stock's productivity (Elison et al. 2024a; Elison et al. 2024b).

Regulation of the Nushagak District salmon fisheries is further complicated by the shortcomings of the DIDSON sonar system used to estimate Chinook and sockeye salmon escapement, which was demonstrated to be inaccurate and inconsistent in measuring salmon passage. An acoustic tagging study conducted on Chinook salmon passing the sonar indicated that the DIDSON sonar array fails to ensonify the entire river, with an estimated 47 – 65% of Chinook salmon passing outside of the range of the sonar beams, through the middle of the river (Maxwell et al. 2020). Similarly, a 2014 – 2016 mark-recapture study estimated that only 76 – 81% of Chinook salmon that passed through the ensonifed area were enumerated (Data on file with Central Region Research Group, ADF&G, Division of Commercial Fisheries, Soldotna). This issue appears to be exacerbated by the large sockeye salmon runs in the Nushagak River over the last 10 years, which not only tend to push migrating Chinook salmon toward the deeper central channel of the river – outside of the sonar's range – but also overwhelm the sonar systems and saturate the test fishing gillnets used for species apportionment (Maxwell et al. 2020).

Consequently, Nushagak Chinook salmon escapements have been chronically underestimated by the Portage Creek sonar. The acoustic tagging and mark-recapture studies indicated that the sonar undercounts salmon passage by 19 – 65%, and historical Chinook salmon escapement estimates produced by a run reconstruction model developed by Head and Hamazaki (2022) were 38 – 65% higher than the sonar index, or 43% higher on average (Maxwell et al. 2020; Data on file with Central Region Research Group, ADF&G, Division of Commercial Fisheries, Soldotna). This tendency toward undercounting is further evidenced by sockeye salmon passage counts from the Nuyakuk River counting tower, which estimated passages into the Nuyakuk River of 2.30 million sockeye salmon in 2023 and 2.32 million sockeye salmon in 2024, significantly higher than sonar estimates of 1.77 million and 1.72 million in 2023 and 2024, respectively (Nass and Head 2024; ADF&G 2025a; Data on file with BBSRI, Anchorage). The Nuyakuk River, which meets the Nushagak mainstem approximately 90 miles upriver of the sonar site, is estimated to produce roughly half of the sockeye salmon in the Nushagak river system, suggesting that the Portage Creek sonar, located near the mouth of the Nushagak River, has been significantly undercounting sockeye salmon in recent years (Daigneault et al. 2007).

Based on these recent discrepancies between the Nuyakuk Tower and Portage Creek sonar sockeye salmon counts, it has been theorized that the sonar array is being saturated with sockeye salmon during very large runs and is consequently undercounting raw salmon passage. Species-specific counts are estimated by apportioning the raw salmon passage data based on catch ratios observed during gillnet test fishing at the sonar site; therefore, undercounting raw passage also results in undercounting species-specific passages. Not only do these discrepancies demonstrate the potential inaccuracies of escapement estimates, SEG limits and their use as metrics for Chinook salmon productivity, but they also suggest that the Nushagak District commercial and recreational salmon fisheries may be facing unnecessary restrictions in response to underestimated Chinook salmon returns in recent years as sockeye salmon escapements have increased.

The 2022 Nushagak River King Salmon Action Plan Report acknowledges the need for more accurate inseason and postseason escapement data for Chinook salmon to guide area closures, run size estimates and escapement goals (ADF&G 2022). Unless the Portage Creek sonar array can be improved, alternative monitoring methods will be required to produce more reliable counts. While peak aerial surveys are useful for measuring the relative abundance of spawning populations, they only provide an index based on counts conducted on certain sections of the drainage over a short timeframe (1 – 2 days). Moreover, aerial surveys suffer from inherent inconsistencies in pilot and surveyor skill and experience, timing and environmental conditions. Fish weirs and counting towers provide much more consistent and precise measures of escapement because they count passage throughout the entirety of the run in a fixed location and are less susceptible to variability caused by adverse weather conditions. However, due to budgetary and logistical constraints, only three weir and counting tower projects have operated in the Nushagak river system since the 1970's: the Stuyahok River and Iowithla River weirs, which were operated by ADF&G from 2014 – 2016 in conjunction with a mark-recapture study, and the Nuyakuk River counting tower, which was operated from 1959 – 1988 and 1995 – 2006 by ADF&G and from 2023 – present by the Bristol Bay Science and Research Institute (BBSRI) (Nass and Head 2024; Data on file with ADF&G, Division of Commercial Fisheries, Anchorage). Escapement estimates provided by weirs and counting towers are important for constructing brood tables, setting escapement goals and run forecasting, as well as for assessing the accuracy of sonar estimates in the Nushagak River specifically.

In addition to escapement estimates, weirs provide a controlled environment in which to collect age, sex and length (ASL) data and genetic samples from a subset of salmon populations as they pass upstream. This data can provide insights into patterns of stock abundance and spawner-recruit relationships that are critical to developing escapement goals. Weir sites also allow for convenient, long-term assessment of various environmental factors including water temperature, turbidity, and river stage, all of which can influence stock productivity and migration timing.

In 2024, BBSRI began the Nushagak River weir projects to address the need for more robust and reliable Chinook salmon escapement data. In June 2024, two weirs and associated field camps were installed to enumerate adult Chinook salmon migrating upstream to highly productive spawning habitats: one on the Upper Nushagak River, a continuation of the Nushagak River mainstem, and the other on the Koktuli River, which flows into the Mulchatna River, a major tributary of the Nushagak drainage. Mobilization of these weirs was the first stage of the Nushagak River Chinook Salmon Assessment Program, an effort to develop an index of Nushagak River Chinook salmon abundance independent from the Portage Creek sonar and peak spawning aerial survey program. This program will also expand to include aerial drone surveys, citizen catch reporting and mark-recapture projects in future years.

Goals and Objectives

The primary goals of the Nushagak River weir projects are to record daily counts of adult Chinook salmon migrating to spawning grounds on the Upper Nushagak and Koktuli rivers, and to collect ASL data from Upper Nushagak River and Koktuli River Chinook salmon. Since they comigrate with Chinook salmon, these efforts were extended to chum and sockeye salmon as well, although they are not the primary species of interest for this study.

Objectives:

1. Enumerate daily and total annual Chinook salmon passage on the Upper Nushagak and Koktuli rivers using fixed picket weirs from June 28 to August 15, and record chum and sockeye salmon passage data during this period.
2. Collect ASL and genetic data from Chinook, chum and sockeye salmon on the Upper Nushagak and Koktuli rivers, with sampling goals of 230 individuals for each species.

This report outlines the operations and methods of the 2024 field season as well as the data collected at the Upper Nushagak and Koktuli weirs.

Methods

Assessment Locations

Upper Nushagak Weir

The Upper Nushagak River is a glacial river that flows southwest from its headwaters to the confluence with the Chichitnok River, where it joins the Nushagak River mainstem. Aerial surveys of the Upper Nushagak River, from the Chichitnok River to Big Bend, were flown intermittently between 1968 – 2024 and accounted for over 27% of Chinook salmon counted during surveys of the Nushagak drainage in both 2021 and 2022, with an average of 11.7% since 1968 (Dye et al. 2006; Data on file with ADF&G, Division of Commercial Fisheries, Anchorage). Notably, these surveys do not cover the entire Nushagak river system, and in many years, including 2022, some sections were not surveyed. Similarly, a 2006 radiotelemetry study operated by BBSRI detected 10.2% of Chinook salmon radio-tagged in Ekwok in the upper portion of the Nushagak mainstem, upstream of the King Salmon River (Daigneault et al. 2007). These data suggested high Chinook salmon productivity in the Upper Nushagak River, making it a good candidate for a weir site. The Upper Nushagak weir site is roughly 36 river miles (RMI) downstream from the Big Bend section of the Nushagak River and 1.5 RMI upstream of the confluence with the Chichitnok River. The site is located at lat. 60.393122 long. -157.245789, which is 76 RMI above the nearest village, Koliganek, and 193 RMI from Dillingham (Figure 2).

The weir is approximately 50 m from bank-to-bank, on a compact, medium-sized gravel substrate. The field camp is located on the north bank upstream of the weir. The main river channel runs along the southern bank and is typically around 3.5 ft deep during the weir's operational period. From the edge of the main channel to the north bank, the river is typically between 2.5 – 3 ft deep, becoming gradually shallower from south to north.

Koktuli Weir

The Koktuli River is a heavily braided, nonglacial river that flows west from its headwaters as separate North and South forks which converge and eventually meet the larger Mulchatna River. It is a popular sport fishing destination in the summer, although not to the degree of the lower Nushagak River (Schwanke 2007; Dye and Fo 2015). The Koktuli River also received heightened public attention in the 2000's – 2010's, as the proposed Pebble Mine site was near its headwaters. Historical data from aerial surveys flown on the Koktuli River between 1968 – 2022 suggest that the Koktuli River produces 22.5% of the Nushagak drainage's surveyed Chinook salmon spawning population on average, however this estimate is likely not representative of the Koktuli River Chinook salmon proportion within the Nushagak system because it only accounts for river sections on which surveys were flown, rather than the entire drainage-wide population (Dye et al. 2006; Data on file with ADF&G, Division of Commercial Fisheries, Anchorage). BBSRI's 2006 radiotelemetry study detected 11.3% of tagged Chinook salmon in the Koktuli River, which is a more reliable proportion estimate than those derived from aerial survey counts (Daigneault et al. 2007). Based on these data, the Koktuli River was considered a high priority weir site candidate. The Koktuli weir site is approximately 6 RMI upstream of the confluence of the Koktuli and the Mulchatna rivers and 2 RMI below the confluence of the Koktuli and Swan rivers, at lat. 59.973822 long. -156.247492. The site is roughly 64 RMI upriver from Koliganek and 157 RMI upriver from Dillingham (Figure 2).

The weir is approximately 48.5 m across from bank-to-bank, on a large, loose gravel substrate. The camp is located on the south bank just downstream of the weir. From the south bank to the center of the river, the water is typically between 2 – 2.5 ft deep with a deeper 2.5 – 3 ft secondary channel running just off the south bank. The main channel runs along the north bank and can be as deep as 4 – 4.25 ft during typical inseason conditions. The river bottom of the main channel is rocky and uneven, with almost no gravel in some places.

Weir Design

A fixed picket weir design was chosen for both weirs because the relatively stable river stages and lack of debris load at both weir sites did not necessitate floating panel weirs, which are more difficult to install and maintain. The fixed weirs are composed of bulwarks of stainless-steel tripods, anchored to the riverbed with duckbill anchors, with 12' x 2" aluminum pipe stringers laid between them. Along the stringers, 2 ¾' x 6' and 2 ¾' x 7' welded aluminum picket panels are laid to create a fish-tight barrier that spans the river (Photo 3). The panels are held in place against the stringers by water pressure primarily, allowing them to separate or be easily removed if struck by large debris. The panel pickets are ½" nominal sch. 40 aluminum pipes spaced 2 ¼" apart on center, creating a gap no larger than 1 ¾" between pickets, which is narrow enough to prevent adult salmon passage while minimizing weight and drag.

The weirs are fitted with aluminum frame and picket livetraps, with upstream and downstream gates used to pass fish and load the trap for sampling. The trap frame is 5' x 8' x 5', with pickets spaced approximately 1.5" apart. The traps were placed between the 5th and 6th tripods from the camp-side bank, where river profiles were relatively flat and water levels would remain deep enough to hold fish throughout the season. Floating panel boat gates were installed on the opposite end of the weirs, adjacent to the deepest section of the main channel where boat traffic is the heaviest. The 20' floating panels were anchored to 9' stainless steel rails and fitted with resistance boards on the downstream ends, which could be adjusted to keep the panels afloat as the river stage changed. These boat gates allowed jet-propelled skiffs to cross the weir unassisted while maintaining fish-tightness.

Operations

The target operational period for both weirs was June 28 to August 15, which was based on average Chinook salmon run timings documented in similar river systems. The Stuyahok River weir, which last operated from 2014 – 2016, provided the only comparable dataset in the Nushagak drainage and showed that an average of 99.4% of the Chinook salmon run passed the weir site between June 28 and August 6 (Data on file with ADF&G, Division of Commercial Fisheries, Anchorage). Of the 3 years that the Stuyahok weir operated, the earliest-passing Chinook salmon was counted on June 23 in 2014, and no Chinook salmon were counted until June 27 in 2015 and June 28 in 2016. The latest-passing Chinook salmon was counted on August 8 in 2014, and none passed on August 9 of that same year. An operational period of June 28 to August 15 was deemed sufficient to cover the entirety of the Chinook salmon runs on the Koktuli and Upper Nushagak rivers, as they are both upriver of the Stuyahok site.

Weir and camp materials were acquired in Anchorage, Alaska and shipped to Dillingham, Alaska on Northline Seafoods tender vessels. All equipment was then barged upriver from Dillingham to each campsite by Lifeline Logistics, L.L.C. (Photo 4). Project leaders were met by all four technicians at the Upper Nushagak site on June 22 and began assembling the camp and weir. The Koktuli weir technicians and one project leader traveled to the Koktuli weir site by skiff on June 29 and began weir and camp mobilization on June 30. Each camp was staffed by two technicians for the entirety of the season and was visited periodically by project leaders.

Abiotic Data

Abiotic data was collected twice each day, once at 0800 hours and once at 1700 hours. These data included cloud cover, precipitation volume (mm), air temperature (°C), surface water temperature (°C), river stage (cm), and water clarity. Analog thermometers were fixed to the weir, one in the water and the other suspended in midair, to record surface water and air temperature. A rain gauge was mounted to a picket near the weir in an exposed area and emptied after it was checked to measure rainfall between each weather report. A staff gauge was mounted in the river near the weir to measure river stage. Onset HOBO® water temperature loggers were also fixed to the riverbed at each weir site at the beginning of the field season to collect year-round water temperatures and will be retrieved and replaced at the beginning of the 2025 season. All abiotic data was recorded on paper data sheets and digitized at the end of each day.

Fish Passage and Enumeration

Passage counts were conducted on every operational day; a minimum of three counts were required on days when sampling also occurred, or four counts if no sampling was done. Counts were scheduled in regular intervals to minimize the weir's impact on normal salmon migration, typically 3 – 4 hours apart, with one in the morning, another at midday, an evening sampling session, and a final count at night. Additional counting sessions were added as needed when salmon migration volume increased to prevent the accumulation of fish below the weirs. Counts were conducted for a minimum of 1 hour, although they were extended if there were salmon below the weir indicating an intent to pass after the 1-hour mark. When counting, both gates of the livetrap were opened and the technician on duty would tally each species of salmon separately as they passed upstream, keeping separate counts for male and female Chinook salmon. Chinook salmon sex was determined visually based on body profile, presence of kype, and belly size. Chum and sockeye salmon were not distinguished by sex during passage counts, nor was any other species besides Chinook salmon.

After each count, technicians walked the length of the weir, removed debris and repaired any gaps in the weir large enough for fish to pass through. Periods of time during which the weir was not fish-tight were noted on the field forms. Days during which the weir was not fish-tight for longer than 2 consecutive hours were considered "partial" days.

ASL and Genetic Sampling

Sampling Goals

Daily and weekly sampling goals were adjusted to accommodate fluctuations in migration volume throughout the season, however a predetermined season-long sampling goal of 230 fish was instituted for Chinook, chum and sockeye salmon. Minimum sample sizes were selected to achieve 95% CI with estimates no wider than ± 10%, ($\alpha = 0.05$ and $d = 0.10$) (Bromaghin 1993). As there was no historical data for either river, probable population sizes for each of the studied Pacific salmon species were extrapolated from weir enumeration records from the Stuyahok River weir, as well as similarly sized tributaries of the Kuskokwim drainage (Head and Hansen 2018; Data on file with ADF&G, Division of Commercial Fisheries, Anchorage). Ten age-sex categories were assumed for Chinook salmon ($n = 190$), 8 for chum salmon ($n = 180$) and 14 for sockeye salmon ($n = 205$). Sample size goals were conservatively increased to 230 for all species due to the lack of historical data and to account for lost, damaged and unreadable scales, sampling errors and run timing variation. Daily sampling goals were adjusted regularly to reflect roughly 5 – 10% of the previous day's count, with the intention of avoiding disproportionate over- or under-estimation of any segment of the run.

Sampling Operations

At least one sampling session was to be conducted per day, however the total daily sampling time was limited to 1.5 hours. Loading the livetrap for sampling was accomplished using two methods: passive sampling and active sampling. During passive sampling, the downstream fyke gate of the livetrap was opened to allow fish to swim into the trap. When a sufficient number of salmon had been captured, the gate was closed. This could be done with a technician sitting on the trap ready to close the gate, or the trap could be left unattended for up to one hour, so long as it was checked at least every 15 minutes.

During active sampling, both the upstream and downstream gates were left open and fish were counted as they passed upstream. When fish of the target species entered the livetrap, both gates were quickly closed and all captured fish were sampled. Active sampling was typically used when Chinook salmon had been hesitant to enter the trap during passive sampling, or when sampling volume for a certain species needed to be increased selectively. For both passive and active sampling, all salmon held in the trap were sampled to avoid selection bias. If too many fish were loaded into the trap, all fish were counted and released upstream without being sampled, and the trap was reloaded.

Sampling Procedure

Chinook, chum and sockeye salmon were sampled for mid-eye to fork length (mm, MEFK), species and sex, and scales and fin clips were collected from each. Each fish was placed in an aluminum cradle with a sliding measuring stick and relief cuts for accessing scales and fins, which made sampling easier for weir staff and safer for the fish. The species of each fish was visually determined based on body morphology and coloration, presence of tail and back spots and mouth/jaw coloration. Sex was visually determined based on typical sexual morphology (presence of kype; size, shape and softness of belly; presence of ovipositor). Technicians were required to confirm the presence of an ovipositor for all Chinook salmon measured under 700 mm and identified as female. Length measurements were taken by holding the snout of each fish against the front of the cradle, sliding the measuring stick to be in line with the eye and measuring to the center of the caudal fin fork. Sex, length and fish number were recorded on species-specific sampling sheets during each sampling session.

Three scales were taken from Chinook salmon, and one scale was taken from both chum and sockeye salmon for aging. Scales were taken from the "preferred area," 2 – 3 scales above the lateral line on the left side, between the posterior insertion of the dorsal fin and the anterior insertion of the anal fin (Appendix A1; Mosher 1963). If no acceptable scales were available in the preferred area, scales were taken from near the preferred area on the left side or from the preferred area on the right side of the fish. Fin clip samples for genetic stock analysis were taken from the pelvic fin tip and dried on Whatman cards using desiccant packs (Appendix A2). Separate scale and fin clip cards were used for each species and sampling session. Once sampled, all fish were released upstream of the weir.

All data was recorded on paper data sheets and digitized at the end of each day. Scale and fin clip cards were dried and stored on site as directed by ADF&G's Gene Conservation Laboratory (GCL) (Appendix A2). Post-season, fin clip samples were delivered to the GCL for archival storage. Scale cards were pressed and imaged at BBSRI's Anchorage office and ADF&G's Anchorage office, and digital scale images and pressed acetate cards were transferred to ADF&G Region II Comm. Fish. for aging.

Scale Aging

Scale aging was completed by ADF&G in Anchorage. Impressions of all scale cards were made into 0.02 mm thick acetate cards post-season using a GeoKnight K20S heated press (200 °F, 120 psi, 2:00 min) at BBSRI's Anchorage office, and a Phi P-21 hydraulic press (167 °F, 42,000 psi, 3:00 min) at ADF&G's Anchorage office. Scale impressions were digitally imaged at BBSRI's Anchorage office using a Nikon Ti2 inverted microscope (2x 0.1 APO objective) and a customized NIS Elements AR software program. Scale images were uploaded to a cloud-based database, linked to their corresponding ASL data files, and transferred to ADF&G Region II Comm. Fish. staff for aging.

During scale aging, the patterns of rings (circuli) visible in the scale under magnification are analyzed to determine how many years each fish spent in the freshwater and ocean life stages. During the winter, lower growth rates cause these circuli to condense together, forming one dark band (annulus) for each winter the fish was alive (Fisher and Pearcy 1990). Scale agers count these annuli to estimate the freshwater and ocean ages of each fish, documenting them using European notation (Koo 1955; Mosher

1969). Total fish age is equal to the sum of the freshwater age and the ocean age, plus one year to account for the embryonic life stage before scales are developed.

Results

Weir Operations

Upper Nushagak Weir

The Upper Nushagak weir operated for 44 consecutive days, from June 29 – August 11, in 2024. On six of those days, holes were observed in the weir that were large enough to significantly compromise fish-tightness for longer than 2 hours, and they were therefore counted as partial days. Instances where the weir was not fish-tight decreased significantly after the upstream side of the weir was lined with sandbags, around July 18. Weir operations were terminated on August 11 due to high water levels, four days earlier than the end of the target operational period. River stage at the Upper Nushagak weir was typically measured between 58 – 70 cm, with a season average of 64 cm and a maximum of >100 cm recorded on August 12 (Figure 3). The weir did not suffer any structural failures when the river stage exceeded 100 cm; however, when the stage surpassed the height of the livebox on the morning of August 12, the weir was no longer fish-tight and was therefore demobilized for the season.

Surface water temperatures measured from the weir averaged 10.5 °C and ranged from 8 °C to 18 °C; air temperatures averaged 13.6 °C and ranged from 7 °C to 31 °C (Figure 4).

Koktuli Weir

The Koktuli weir operated for a total of 24 days from July 6 – August 6 in 2024, with a midseason outage from July 14 – 21. There were four partial days due to loss of fish-tightness. Installation of the Koktuli weir was delayed beyond the intended start date of June 28, as the construction of the Upper Nushagak camp and weir was prioritized at the beginning of the season. Operations were twice suspended at the Koktuli weir due to structural failures caused by high water and riverbed scouring. The first of these outages occurred at 2300 hours on July 14, and the weir remained out of operation until it was reinstalled approximately 30 m upriver at 2300 hours on July 21. The second outage began at 1900 hours on August 6, after which the weir and camp were demobilized for the season in anticipation of continued heavy rainfall and high water.

River stage at the Koktuli weir was typically measured between 30 – 40 cm and averaged 37 cm for the season, but it rose as high as 70 cm on August 8 during a period of heavy rainfall (Figure 5). Both structural failures of the weir occurred at river stages of approximately 50 cm, which may be the operational limit for this site.

Surface water temperatures measured at the weir averaged 11.5 °C and ranged from 8 °C to 17.5 °C, and air temperatures averaged 12.9 °C and ranged from 6 °C to 28 °C (Figure 6).

Weather reports for both weirs are available in Appendix B – Weir Weather Logs.

Salmon Enumeration

Upper Nushagak Weir

From June 29 – August 11, 2,206 Chinook, 7,259 chum and 1,369 sockeye salmon were counted at the Upper Nushagak weir (Table 1). One pink salmon (*Oncorhynchus gorbuscha)*, 3 coho salmon (*Oncorhynchus kisutch)* and 20 Dolly Varden (*Salvelinus malma*) were also counted at the weir (Appendix C1). Of the 2,206 Chinook salmon counted, 1,512 (68.5%) were male and 694 (31.5%) were female.

Koktuli Weir

From July 6 – August 6, 966 Chinook, 5,940 chum and 2,166 sockeye salmon were counted at the Koktuli weir (Table 2). Two pink salmon and 50 Dolly Varden were also counted at the weir (Appendix C2). Of the 966 Chinook salmon counted, 611 (63.3%) were male and 355 (36.8%) were female.

Run reconstructions for missed passage were not possible for the 2024 season at either weir due to the lack of historical data.

Age-Sex-Length

Chinook Salmon

Age, sex, length and genetic samples were collected from 174 Chinook salmon at the Upper Nushagak weir (7.9% of total count) and 87 Chinook salmon at the Koktuli weir (9.0% of total count) (Table 3). Upper Nushagak Chinook salmon were 35.6% female and had an average length of 651 mm, with lengths ranging from 355 mm to 895 mm. Chinook salmon sampled at the Koktuli weir were 33.3% female and had an average length of 637 mm, with lengths ranging from 340 mm to 870 mm. Female Chinook salmon were longer on average at both weirs.

Visual sex identification of Chinook salmon during passage counts produced sex ratios similar to those of visual sex identification during sampling at both weirs. At the Upper Nushagak weir, 31.5% of passing Chinook salmon were identified as female, while 35.6% of sampled Chinook salmon were identified as female. At the Koktuli weir, 36.8% of passing Chinook salmon were identified as female, while 33.3% of sampled Chinook salmon were identified as female.

Ages were determined for 172 Chinook salmon sampled at the Upper Nushagak weir (Table 4). The 1.3 age class was the most prevalent, representing 47.1% of aged individuals, followed by the 1.2 age class, which represented 37.8% of aged individuals. The 1.3 age class had an average length of 715 mm and was 55.6% female, while the 1.2 age class had an average length of 555 mm and was 1.5% female.

Conversely, of 85 aged Chinook salmon sampled at the Koktuli weir, the 1.2 age class was the most prevalent (50.6%) followed by the 1.3 age class (36.5%) (Table 4). The average length of 1.2-aged Chinook salmon was 564 mm and 9.3% were female, and the 1.3 age class averaged 749 mm and was 61.3% female.

Chum Salmon

Age, sex, length and genetic samples were collected from 186 chum salmon at the Upper Nushagak weir (2.6% of total count), and 196 chum salmon at the Koktuli weir (3.3% of total count) (Table 3). Upper Nushagak chum salmon were 24.0% female and had an average length of 547 mm, with lengths ranging from 450 mm to 620 mm. Koktuli chum salmon were 28.1% female and had an average length of 556 mm, with lengths ranging from 445 mm to 660 mm. On average, male chum salmon were larger at both weirs.

Of the chum salmon sampled, 172 were successfully aged from the Upper Nushagak weir and 174 from the Koktuli weir (Table 4). The 0.3 age class was most prevalent at both weirs, representing 57.0% of successfully aged chum salmon from the Upper Nushagak weir and 66.7% from the Koktuli weir. 0.3-aged chum salmon from the Upper Nushagak weir had an average length of 543 mm and were 16.3% female, while those from the Koktuli weir had an average length of 556 mm and were 28.4% female.

The second most common age class at both weirs was 0.4, which represented 31.4% and 28.2% of aged chum salmon from the Upper Nushagak and Koktuli weirs, respectively (Table 4). 0.4-aged chum salmon had an average length of 561 mm and were 33.3% female at the Upper Nushagak weir, and had an average length of 566 mm and were 22.4% female at the Koktuli weir.

Sockeye Salmon

Age, sex, length and genetic samples were collected from 99 sockeye salmon at the Upper Nushagak weir (7.1% of total count), and 49 sockeye salmon at the Koktuli weir (2.3% of total count) (Table 3). Upper Nushagak sockeye salmon were 36.4% female and had an average length of 503 mm, with lengths ranging from 365 mm to 605 mm. Koktuli sockeye salmon were 67.3% female and had an average length of 488 mm, with lengths ranging from 361 mm to 596 mm. On average, males were larger at the Upper Nushagak weir and females were larger at the Koktuli weir.

Of the sockeye salmon sampled, 34 of those sampled at the Upper Nushagak weir were successfully aged, while 65 were unable to be aged due primarily to resorption (Table 4). Of those sampled at the Koktuli weir, 42 were able to be successfully aged while only 7 were not. The predominate age class for sockeye salmon was 1.3 at both the Upper Nushagak weir and the Koktuli weir, representing 73.5% and 59.5% of aged individuals, respectively. 1.3-aged sockeye salmon sampled at the Upper Nushagak weir had an average length of 518 mm and were 64.0% female, and those from the Koktuli weir had an average length of 498 mm and were 88.0% female.

The 1.2 age class was the second-most common age class at the Koktuli weir (14.3%), however no 1.2-aged sockeye salmon were sampled at the Upper Nushagak weir (Table 4). 1.2-aged sockeye salmon from the Koktuli weir had an average length of 426 and were 0.0% female.

Freshwater age 0 sockeye salmon (age classes 0.2 and 0.3) made up 8.8% of ageable individuals at the Upper Nushagak weir and 11.9% at the Koktuli weir (Table 4).

Mortalities

No mortalities of any salmonid species directly or indirectly related to weir operations, enumeration nor live sampling were observed at either weir.

Discussion

Operations

The Upper Nushagak and Koktuli weirs and camps were successfully mobilized and operated in 2024. However, the target operational period of June 28 – August 15 was not met at either site due to both logistical constraints and high-water conditions. As both camps have already been established and most weir components are assembled at the sites, mobilization is expected to be on schedule in subsequent seasons. Operations at both weirs were impacted by riverbed scouring, which resulted in partial count days at both sites and complete outages at the Koktuli weir. The scouring issue will be addressed by reinforcing the weir design, both by lining the base of the weir panels with sandbags immediately after installation to prevent scouring and by weighing down tripods with sandbags to improve their stability. The Koktuli weir and camp may be relocated in 2025 to a secondary site approximately 2 RMI downriver where the gravel substrate is more stable and the bottom profile is more favorable.

Salmon Enumeration

Chinook Salmon

Preliminary data show that the 2024 Nushagak Chinook salmon run continued a trend of low returns. The total reported Chinook salmon commercial harvest for Bristol Bay was 6,895, which was the lowest harvest in at least the past 20 years (Elison et al. 2024b). The Nushagak District Chinook salmon commercial harvest was 4,340, representing 62.9% of the Bristol Bay total. The Portage Creek sonar Chinook salmon escapement index was 47,896 fish, falling below the lower SEG limit of 55,000 for the fifth year since 2019 (ADF&G 2025a). However, the 2024 escapement index was the second highest since 2019, marking a relatively small increase from the all-time low of 31,499 observed in 2023. This year's run was higher than the 5-year average of 44,417 (2020 – 2024), but lower than the 10-year average of 64,644 (2015 – 2024). Therefore, Chinook salmon passage counts taken at the Upper Nushagak and Koktuli weirs in 2024 were likely significantly lower than average historical run sizes.

The Chinook salmon count at the Upper Nushagak weir was 5.3% (2,206) of the Portage Creek sonar Chinook salmon escapement index, and the Koktuli weir count was 2.3% (966) of the sonar index. These percentages are lower than the proportions estimated by BBSRI's 2006 radiotelemetry study, which detected 10.2% of tagged Chinook salmon on the mainstem Nushagak River above the King Salmon River, and 11.3% on the Koktuli River (Daigneault et al. 2007). The Upper Nushagak weir's count is likely an accurate representation of Chinook salmon passage in the Upper Nushagak River in 2024, as no Chinook salmon were observed during the first five days of operations (June 29 – July 3), and only 14 were observed during the last two days of operation (August 9 and 10). Missed passage during inoperable periods at the Koktuli weir likely contributed to the discrepancy between the weir count and radiotelemetry proportions for the Koktuli River, however it is also likely that the distribution of

Nushagak drainage Chinook salmon has changed since 2006. Jordan Head, Executive Director of BBSRI, reported seeing significantly fewer Chinook salmon on the Koktuli River in 2024 than in previous years while flying aerial surveys for ADF&G (Jordan Head, BBSRI, personal communication).

The inseason weir outage on the Koktuli River (July 14 – 21) appeared to coincide with the peak of the Chinook salmon run, likely resulting in a considerable amount of missed passage. During this period, 43% of the Upper Nushagak weir's total Chinook salmon count were counted, suggesting that Chinook salmon passage rates may have been high at the Koktuli weir as well (Table 1; Table 2; Figure 7). Chinook salmon passage counts at the Koktuli weir were relatively low from July 6 – 14, never surpassing 40 individuals on any day, yet 125 were counted on July 22, the first operational day following reinstallation, which was the highest observed passage of the season. The Upper Nushagak weir, in contrast, counted over 370 Chinook salmon on both July 19 and July 21, and over 270 on July 22 and July 23. Based on these observations, it is likely that the peak of the Koktuli River Chinook salmon run occurred during the Koktuli weir's inseason outage, and that only the tail end of it was enumerated immediately following reinstallation.

This theory is further supported by anecdotal evidence from local sport fishing guides, who reported seeing "thousands" of Chinook salmon upstream of the weir site during this seven-day period (Ryan Kocherhans, Alaskan Remote Adventures, personal communication). Research on salmonid migratory behavior suggests that the high-water conditions at this time may have encouraged Chinook salmon that were staging downstream of the Koktuli weir to push upriver (Quinn 2018). However, in 2024, there was no obvious correlation between river stage and passage volume at either weir during other high-water periods. Unfortunately, the lack of historical run-timing data precludes any statistical analysis of the effect of river stage on passage.

Chum Salmon

The Portage Creek sonar estimated a total escapement of 311,201 chum salmon in 2024, which was significantly higher than the most recent 5-year average of 155,271 (2020 – 2024), but less than half of the 2019 index of 651,164 (ADF&G 2025a). The 10-year average run size for Nushagak River chum salmon is 336,303 (2015 – 2024), which is comparable to this year's run. In 2024, chum salmon counts at the Upper Nushagak and Koktuli weirs were 2.3% (7,259) and 1.9% (5,940) of the chum salmon sonar index, respectively.

The Upper Nushagak weir appeared to operate throughout the vast majority of the Upper Nushagak River chum salmon run, counting only 27 chum salmon on the first day of operation (June 29) and 28 on the last day of operation (August 11). Therefore, the Upper Nushagak weir's chum salmon passage count can be considered an accurate representation of chum salmon returns in the Upper Nushagak River in 2024 (Table 1; Figure 8). However, the Koktuli weir may have missed significant portions of the chum salmon return, both before the weir was installed on July 6 and during the July 14 – 21 outage, as these periods coincided with 20% and 34% of observed chum salmon passage at the Upper Nushagak weir, respectively (Table 1; Table 2; Figure 8). On the first day of operation, 255 chum salmon were counted at the Koktuli weir, and after reinstallation on July 22, 302 chum salmon were counted; both observations suggest significant chum salmon passage during prior inoperable days (Table 2; Figure 8). For these reasons, the Koktuli weir chum salmon passage count should not be considered an accurate approximation of chum salmon returns on the Koktuli River in 2024.

Sockeye Salmon

The Portage Creek sonar estimated the Nushagak River sockeye salmon escapement to be 1,692,004, just below the 10-year average of 1,913,171 (2015 – 2024) and significantly lower than the 5-year average of 2,569,062 (2020 – 2024) (ADF&G 2025a). This 5-year average was inflated by unprecedented escapement indexes in 2021 and 2022 and is therefore less reflective of typical historical run sizes than the 10-year average (ADF&G 2025a). However, preliminary data from the Nuyakuk counting tower estimated a total passage of 2.3 million sockeye salmon into the Nuyakuk River alone in 2024, 36% higher than the sonar estimate for the entire Nushagak drainage (Data on file with BBSRI, Anchorage).

In 2024, sockeye salmon counts the Upper Nushagak and Koktuli weirs were 0.08% (1,369) and 0.13% (2,166) of the sonar count, respectively. These proportions are significantly lower than those estimated by BBSRI's radiotelemetry study, which detected 3.2% of tagged sockeye salmon in the Nushagak River mainstem upstream of the King Salmon River and 10.2% in the Koktuli River (Daigneault et al. 2007). However, historical genetic analysis has shown that large sockeye salmon runs in the Nushagak River are primarily driven by stocks from the Nuyakuk River and associated lake system (Wes Larson, NOAA Auke Bay Laboratories, personal communication). The Nushagak River is currently experiencing some of the largest sockeye salmon runs in its history, so it is reasonable to assume that the river-type sockeye salmon from the Koktuli and Upper Nushagak rivers are making up smaller proportions of the total sockeye salmon run than they did in lower run years, such as when the telemetry distribution study was performed. Moreover, a large portion of the Koktuli River sockeye salmon run likely passed upriver before the weir was installed on July 6, based on the high sockeye salmon counts observed in the first two days of operation as well as historical aerial survey counts of the Koktuli River (Table 2; Figure 9) (Data on file with ADF&G, Division of Commercial Fisheries, Anchorage).

Nearly the entire sockeye salmon run was likely enumerated at the Upper Nushagak weir, as only 5 sockeye salmon were counted during the first week of operation (June 29 – July 5) and 32 were counted in the last week of operation (August 8 – August 11) (Table 1; Figure 9). However, large portions of the Koktuli River sockeye salmon run were likely missed at the Koktuli weir before the first operational day and during the midseason outage, as 924 sockeye salmon were counted in the first two days (July 6 and 7) and 55 were counted on the first operational day following reinstallation (July 22) (Table 2; Figure 9). It is unlikely that a significant portion of the Koktuli River sockeye salmon run was missed following weir demobilization, as only 13 were counted on August 5, the last full day of operation before the weir was removed. Notably, the Koktuli River appears to host a larger sockeye salmon run than the Upper Nushagak River, as nearly 800 more sockeye salmon were counted at the Koktuli weir despite operating for just over half as many days compared to the Upper Nushagak weir (Table 1; Table 2).

Sampling

Sampling goals (n = 230) were not met for any species at either weir in 2024. The minimum sample size was met for chum salmon (n = 180) at both weirs, but not for any other species (Table 3). Technicians reported that Chinook salmon were hesitant to enter the livebox in the latter half of the season, especially when chum and sockeye salmon passage volumes were high. Technicians had some success trapping Chinook salmon using active sampling techniques during times of day when Chinook salmon passage was highest, typically in the late evening. Active sampling techniques and multiple daily sampling sessions should be used more frequently in future seasons if daily sampling goals are not met. The Koktuli weir crew faced additional difficulty meeting their sampling goals due to extended outages, which may be addressed by reinforcing the weir in its existing location or relocating it to a more stable site.

Due to the lack of representative sample sizes, little can be inferred from salmon age composition data collected at the weirs in 2024. Most notable is the proportion of unageable sockeye salmon scales from the Upper Nushagak weir, which represented 67% (65) of all scales collected (99) (Table 4). Of these 65 unageable scales, 54 were illegible due to either severe resorption (51) or regeneration (3) while 11 were inverted or missing. Of the sockeye salmon with resorbed scales sampled at the Upper Nushagak weir, 63% were female, a proportion much higher than the 36.4% identified as female during sampling, indicating that male sockeye salmon may be overrepresented in the Upper Nushagak weir's sockeye salmon age composition for 2024 (Table 3). Only 7 (14%) of the sockeye salmon scales collected at the Koktuli weir were not ageable, and of those 11 only 5 were resorbed or regenerated. Due to the prevalence of resorption and regeneration, the Upper Nushagak weir may be too far upriver to practically estimate sockeye salmon age compositions in the future.

Only 1 Chinook salmon scale from the Upper Nushagak weir was unagable to due regeneration, and none from the Koktuli were unagable due to resorption nor regeneration (Table 4). There were 4 chum salmon scales from the Upper Nushagak weir that were unagable due to regeneration and 7 from the Koktuli weir, and none were unagable due to resorption from either weir.

Recommendations

- Both weirs should be operational by June 28 in the 2025 season. This will likely not require any changes to the season schedule, as the weir and camp materials are already on-site.

- The Koktuli weir may be relocated in subsequent seasons if weir stability continues to be a challenge. For the 2025 season, the camp and weir will likely remain in their current locations, however the tripods will be more heavily secured using lumber and sandbags.

- Riverbed scouring should be addressed in the future by lining the weirs with sandbags immediately after installation. Vexar sheeting may also be laid underneath the boat gate rail to provide further protection against scouring.

- Sampling efforts should be increased so that minimum and goal sample sizes are met. Staff should be encouraged to utilize passive sampling and to conduct multiple sampling sessions per day if sampling rates are below expectations.

- Sockeye salmon scale sampling at the Upper Nushagak weir may be discontinued in future years due to the prevalence of illegible resorbed and regenerated scales.

- Check-in calls between project leadership and field crews should occur at least bi-weekly to ensure that data collection protocols are being followed.

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Tables

Table 1. Daily, cumulative and cumulative percent passage at the Upper Nushagak weir, 2024.

Chinook						Chum				Sockeye			
Date	Male Count	Female Count	Total Count	Cum.	%	Date	Count	Cum.	%	Date	Count	Cum.	%
6/28 [a]	-	-	-	-	-	6/28 [a]	-	-	-	6/28 [a]	-	-	-
6/29	0	0	0	0	0.0	6/29	27	27	0.4	6/29	0	0	0.0
6/30	0	0	0	0	0.0	6/30	40	67	0.9	6/30	1	1	0.1
7/1	0	0	0	0	0.0	7/1	55	122	1.7	7/1	0	1	0.1
7/2	0	0	0	0	0.0	7/2	107	229	3.2	7/2	1	2	0.1
7/3 [a]	0 [b]	0 [b]	0 [b]	0	0.0	7/3 [a]	196 [b]	425	5.9	7/3 [a]	1 [b]	3	0.2
7/4	1	0	1	1	0.0	7/4	625	1,050	14.5	7/4	2	5	0.4
7/5 [a]	2 [b]	0 [b]	2 [b]	3	0.1	7/5 [a]	391 [b]	1,441	19.9	7/5 [a]	0 [b]	5	0.4
7/6	2	2	4	7	0.3	7/6	353	1,794	24.7	7/6	9	14	1.0
7/7	10	0	10	17	0.8	7/7	225	2,019	27.8	7/7	28	42	3.1
7/8	4	0	4	21	1.0	7/8	214	2,233	30.8	7/8	17	59	4.3
7/9	3	1	4	25	1.1	7/9	263	2,496	34.4	7/9	23	82	6.0
7/10	3	1	4	29	1.3	7/10	454	2,950	40.6	7/10	33	115	8.4
7/11	3	9	12	41	1.9	7/11	109	3,059	42.1	7/11	29	144	10.5
7/12	2	1	3	44	2.0	7/12	121	3,180	43.8	7/12	53	197	14.4
7/13	2	2	4	48	2.2	7/13	239	3,419	47.1	7/13	104	301	22.0
7/14 [a]	7 [b]	4 [b]	11 [b]	59	2.7	7/14 [a]	211 [b]	3,630	50.0	7/14 [a]	72 [b]	373	27.2
7/15 [a]	5 [b]	3 [b]	8 [b]	67	3.0	7/15 [a]	316 [b]	3,946	54.4	7/15 [a]	39 [b]	412	30.1
7/16	38	20	58	125	5.7	7/16	780	4,726	65.1	7/16	76	488	35.6
7/17	33	18	51	176	8.0	7/17	155	4,881	67.2	7/17	24	512	37.4
7/18 [a]	17 [b]	7 [b]	24 [b]	200	9.1	7/18 [a]	238 [b]	5,119	70.5	7/18 [a]	143 [b]	655	47.8
7/19	256	116	372	572	25.9	7/19	365	5,484	75.5	7/19	113	768	56.1
7/20	61	8	69	641	29.1	7/20	209	5,693	78.4	7/20	77	845	61.7
7/21	280	82	362	1,003	45.5	7/21	208	5,901	81.3	7/21	166	1,011	73.8
7/22	191	86	277	1,280	58.0	7/22	147	6,048	83.3	7/22	155	1,166	85.2
7/23	199	74	273	1,553	70.4	7/23	147	6,195	85.3	7/23	67	1,233	90.1
7/24	72	34	106	1,659	75.2	7/24	115	6,310	86.9	7/24	26	1,259	92.0
7/25	38	30	68	1,727	78.3	7/25	132	6,442	88.7	7/25	25	1,284	93.8
7/26	67	33	100	1,827	82.8	7/26	110	6,552	90.3	7/26	4	1,288	94.1
7/27	17	3	20	1,847	83.7	7/27	72	6,624	91.3	7/27	7	1,295	94.6
7/28	14	7	21	1,868	84.7	7/28	75	6,699	92.3	7/28	3	1,298	94.8
7/29	26	14	40	1,908	86.5	7/29	56	6,755	93.1	7/29	14	1,312	95.8
7/30	25	13	38	1,946	88.2	7/30	54	6,809	93.8	7/30	9	1,321	96.5
7/31	24	23	47	1,993	90.3	7/31	71	6,880	94.8	7/31	4	1,325	96.8
8/1	17	13	30	2,023	91.7	8/1	45	6,925	95.4	8/1	1	1,326	96.9
8/2	21	20	41	2,064	93.6	8/2	48	6,973	96.1	8/2	3	1,329	97.1
8/3	9	13	22	2,086	94.6	8/3	31	7,004	96.5	8/3	0	1,329	97.1
8/4	11	18	29	2,115	95.9	8/4	43	7,047	97.1	8/4	8	1,337	97.7
8/5	5	5	10	2,125	96.3	8/5	39	7,086	97.6	8/5	5	1,342	98.0
8/6 [a]	5 [b]	17 [b]	22 [b]	2,147	97.3	8/6 [a]	54 [b]	7,140	98.4	8/6 [a]	8 [b]	1,350	98.6
8/7	11	6	17	2,164	98.1	8/7	24	7,164	98.7	8/7	6	1,356	99.1
8/8	8	8	16	2,180	98.8	8/8	26	7,190	99.0	8/8	2	1,358	99.2
8/9	10	2	12	2,192	99.4	8/9	22	7,212	99.4	8/9	2	1,360	99.3
8/10	4	1	5	2,197	99.6	8/10	19	7,231	99.6	8/10	1	1,361	99.4
8/11	9	0	9	2,206	100.0	8/11	28	7,259	100.0	8/11	8	1,369	100.0
8/12 [a]	-	-	-	-	-	8/12 [a]	-	-	-	8/12 [a]	-	-	-
8/13 [a]	-	-	-	-	-	8/13 [a]	-	-	-	8/13 [a]	-	-	-
8/14 [a]	-	-	-	-	-	8/14 [a]	-	-	-	8/14 [a]	-	-	-
8/15 [a]	-	-	-	-	-	8/15 [a]	-	-	-	8/15 [a]	-	-	-

[a] Weir inoperable for all or part of day

[b] Partial or incomplete count

Table 2. Daily, cumulative and cumulative percent passage at the Koktuli weir, 2024.

Chinook						Chum				Sockeye			
Date	Male Count	Female Count	Total Count	Cum.	%	Date	Count	Cum.	%	Date	Count	Cum.	%
6/28 [a]	-	-	-	-	-	6/28 [a]	-	-	-	6/28 [a]	-	-	-
6/29 [a]	-	-	-	-	-	6/29 [a]	-	-	-	6/29 [a]	-	-	-
6/30 [a]	-	-	-	-	-	6/30 [a]	-	-	-	6/30 [a]	-	-	-
7/1 [a]	-	-	-	-	-	7/1 [a]	-	-	-	7/1 [a]	-	-	-
7/2 [a]	-	-	-	-	-	7/2 [a]	-	-	-	7/2 [a]	-	-	-
7/3 [a]	-	-	-	-	-	7/3 [a]	-	-	-	7/3 [a]	-	-	-
7/4 [a]	-	-	-	-	-	7/4 [a]	-	-	-	7/4 [a]	-	-	-
7/5 [a]	-	-	-	-	-	7/5 [a]	-	-	-	7/5 [a]	-	-	-
7/6	16	7	23	23	2.4	7/6	225	225	3.8	7/6	332	332	15.3
7/7 [a]	6 [b]	1 [b]	7 [b]	30	3.1	7/7 [a]	242 [b]	467	7.9	7/7 [a]	592 [b]	924	42.7
7/8 [a]	9 [b]	4 [b]	13 [b]	43	4.5	7/8 [a]	209 [b]	676	11.4	7/8 [a]	256 [b]	1,180	54.5
7/9	6	8	14	57	5.9	7/9	357	1,033	17.4	7/9	195	1,375	63.5
7/10	1	2	3	60	6.2	7/10	232	1,265	21.3	7/10	68	1,443	66.6
7/11	21	15	36	96	9.9	7/11	586	1,851	31.2	7/11	194	1,637	75.6
7/12	20	15	35	131	13.6	7/12	323	2,174	36.6	7/12	31	1,668	77.0
7/13	6	3	9	140	14.5	7/13	280	2,454	41.3	7/13	18	1,686	77.8
7/14 [a]	-	-	-	-	-	7/14 [a]	-	-	-	7/14 [a]	-	-	-
7/15 [a]	-	-	-	-	-	7/15 [a]	-	-	-	7/15 [a]	-	-	-
7/16 [a]	-	-	-	-	-	7/16 [a]	-	-	-	7/16 [a]	-	-	-
7/17 [a]	-	-	-	-	-	7/17 [a]	-	-	-	7/17 [a]	-	-	-
7/18 [a]	-	-	-	-	-	7/18 [a]	-	-	-	7/18 [a]	-	-	-
7/19 [a]	-	-	-	-	-	7/19 [a]	-	-	-	7/19 [a]	-	-	-
7/20 [a]	-	-	-	-	-	7/20 [a]	-	-	-	7/20 [a]	-	-	-
7/21 [a]	-	-	-	-	-	7/21 [a]	-	-	-	7/21 [a]	-	-	-
7/22	70	55	125	265	27.4	7/22	302	2,756	46.4	7/22	55	1,741	80.4
7/23	46	19	65	330	34.2	7/23	351	3,107	52.3	7/23	78	1,819	84.0
7/24	51	21	72	402	41.6	7/24	500	3,607	60.7	7/24	53	1,872	86.4
7/25	39	31	70	472	48.9	7/25	257	3,864	65.1	7/25	25	1,897	87.6
7/26	26	12	38	510	52.8	7/26	155	4,019	67.7	7/26	22	1,919	88.6
7/27	67	34	101	611	63.3	7/27	214	4,233	71.3	7/27	33	1,952	90.1
7/28	31	21	52	663	68.6	7/28	171	4,404	74.1	7/28	3	1,955	90.3
7/29	43	14	57	720	74.5	7/29	219	4,623	77.8	7/29	25	1,980	91.4
7/30	15	10	25	745	77.1	7/30	182	4,805	80.9	7/30	2	1,982	91.5
7/31	33	12	45	790	81.8	7/31	360	5,165	87.0	7/31	54	2,036	94.0
8/1	14	6	20	810	83.9	8/1	201	5,366	90.3	8/1	13	2,049	94.6
8/2	12	7	19	829	85.8	8/2	154	5,520	92.9	8/2	30	2,079	96.0
8/3 [a]	18 [b]	20 [b]	38 [b]	867	89.8	8/3 [a]	125 [b]	5,645	95.0	8/3 [a]	30 [b]	2,109	97.4
8/4	29	20	49	916	94.8	8/4	116	5,761	97.0	8/4	33	2,142	98.9
8/5	15	8	23	939	97.2	8/5	92	5,853	98.5	8/5	13	2,155	99.5
8/6 [a]	17 [b]	10 [b]	27 [b]	966	100.0	8/6 [a]	87 [b]	5,940	100.0	8/6 [a]	11 [b]	2,166	100.0
8/7 [a]	-	-	-	-	-	8/7 [a]	-	-	-	8/7 [a]	-	-	-
8/8 [a]	-	-	-	-	-	8/8 [a]	-	-	-	8/8 [a]	-	-	-
8/9 [a]	-	-	-	-	-	8/9 [a]	-	-	-	8/9 [a]	-	-	-
8/10 [a]	-	-	-	-	-	8/10 [a]	-	-	-	8/10 [a]	-	-	-
8/11 [a]	-	-	-	-	-	8/11 [a]	-	-	-	8/11 [a]	-	-	-
8/12 [a]	-	-	-	-	-	8/12 [a]	-	-	-	8/12 [a]	-	-	-
8/13 [a]	-	-	-	-	-	8/13 [a]	-	-	-	8/13 [a]	-	-	-
8/14 [a]	-	-	-	-	-	8/14 [a]	-	-	-	8/14 [a]	-	-	-
8/15 [a]	-	-	-	-	-	8/15 [a]	-	-	-	8/15 [a]	-	-	-

[a] Weir inoperable for all or part of day

[b] Partial or incomplete count

Table 3. Season counts and sampling data for Chinook, chum and sockeye salmon at the Upper Nushagak and Koktuli weirs, 2024.

	Chinook		Chum		Sockeye	
	Upper Nush.	Koktuli	Upper Nush.	Koktuli	Upper Nush.	Koktuli
Season Count	2,206	966[a]	7,259	5,940[a]	1,369	2,166[a]
Number Sampled	174	87	186	196	99	49
% Female	35.6	33.3	24.0	28.1	36.4	67.3
Average Length (mm)	651	637	547	556	503	488
Avg Length (mm) - Male	592	574	551	565	507	478
Avg Length (mm) - Female	756	761	534	535	496	493

[a] Partial counts due to shortened operational season and midseason inoperable period

Table 4. Age composition estimates, average length (mm) per age class and female proportion per age class for Chinook, chum and sockeye salmon at the Upper Nushagak and Koktuli weirs, 2024.

CHINOOK	1.1	1.2	X.2	1.3	X.3	1.4	X.4	Total	Unknown
Upper Nushagak									
Number	2	65	6	81	6	11	1	172	2
Percent	1.2%	37.8%	3.5%	47.1%	3.5%	6.4%	0.6%		
% Female	0.0%	1.5%	0.0%	55.6%	33.3%	100%	100.0%		
Avg Length (mm)	375	555	548	715	691	797	820		
Koktuli									
Number	4	43	1	31	1	4	1	85	2
Percent	4.7%	50.6%	1.2%	36.5%	1.2%	4.7%	1.2%		
% Female	0.0%	9.3%	0.0%	61.3%	100.0%	100.0%	100.0%		
Avg Length (mm)	427	564	549	749	740	801	798		

CHUM	0.2	0.3	0.4	0.5	Total	Unknown
Upper Nushagak						
Number	9	98	54	11	172	14
Percent	5.2%	57.0%	31.4%	6.4%		
% Female	33.3%	16.3%	33.3%	27.3%		
Avg Length (mm)	487	543	561	556		
Koktuli						
Number	6	116	49	3	174	22
Percent	3.4%	66.7%	28.2%	1.7%		
% Female	66.7%	28.4%	22.4%	33.3%		
Avg Length (mm)	477	556	566	558		

SOCKEYE	1.1	0.2	1.2	0.3	1.3	2.3	X.3	1.4	X.4	Total	Unkown
Upper Nushagak											
Number	1	0	0	3	25	1	1	2	1	34	65
Percent	2.9%	-	-	8.8%	73.5%	2.9%	2.9%	5.9%	2.9%		
% Female	100.0%	-	-	66.7%	64.0%	100.0%	0.0%	100.0%	100.0%		
Avg Length (mm)	370	-	-	498	518	505	540	515	540		
Koktuli											
Number	0	1	6	4	25	0	2	4	0	42	7
Percent	-	2.4%	14.3%	9.5%	59.5%	-	4.8%	9.5%	-		
% Female	-	0%	0.0%	75.0%	88.0%	-	100.0%	50.0%	-		
Avg Length (mm)	-	374	426	490	498	-	499	545	-		

X.2, X.3 and X.4 refer to fish whose freshwater ages could not be determined.
Unknown refers to individuals whose scales could not be aged due to being regenerated, resorbed, inverted, missing or otherwise illegible.

Figures

Figure 1. Total estimated Nushagak District Chinook salmon run and Nushagak River inriver abundance (Portage Creek Sonar) by year, 2003-2023. Upper and lower SEG limits shown by red lines. (Elison et al. 2024a).

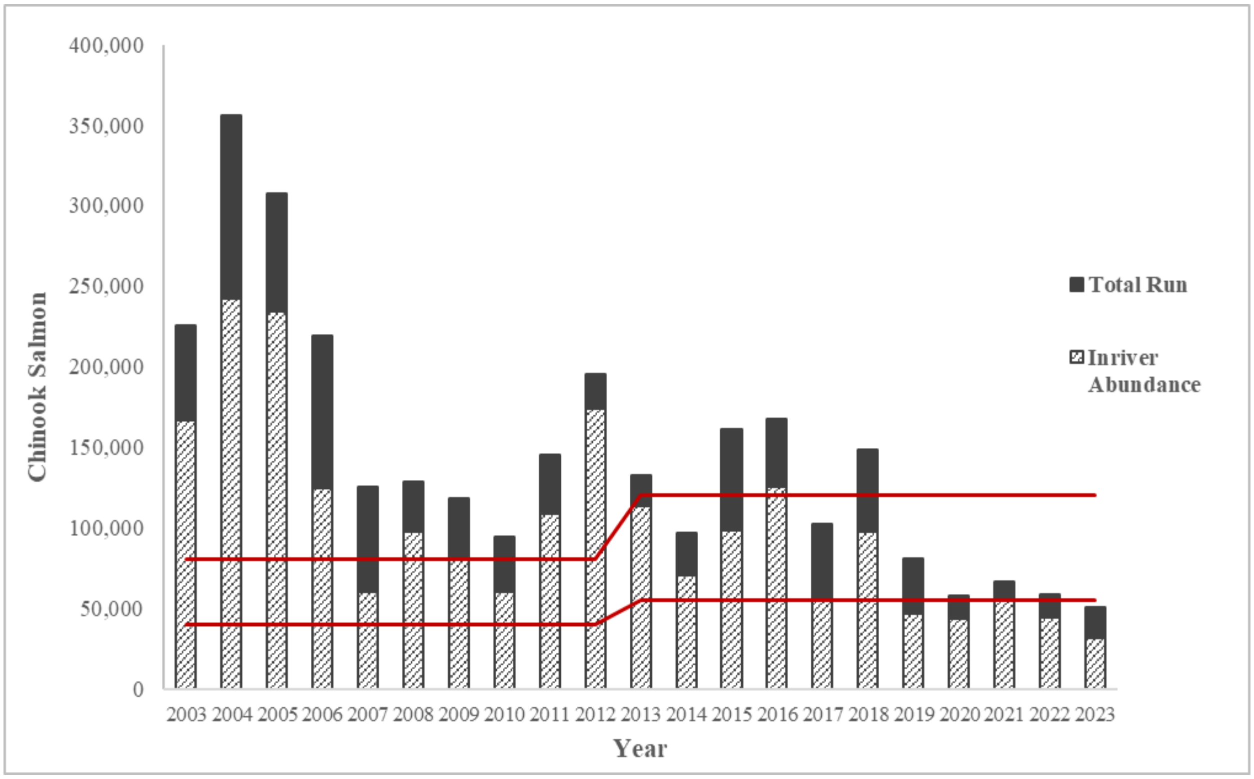


Figure 2. Satellite image of the Nushagak River, showing the locations of the Portage Creek sonar site, the Upper Nushagak weir site, the Koktuli weir site and nearby villages.

Figure 3. Daily river stage measurements (cm) taken at the Upper Nushagak weir, 2024.

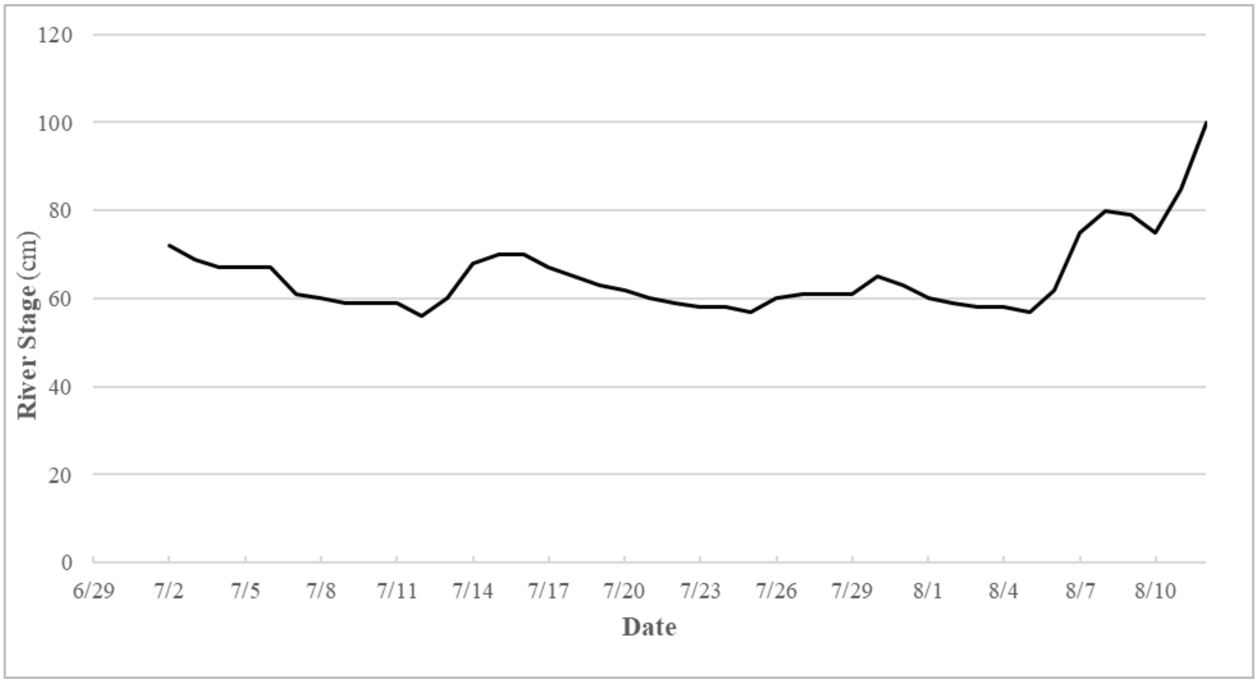


Figure 4. Ambient air and surface water temperatures (℃) taken at the Upper Nushagak weir, 2024.

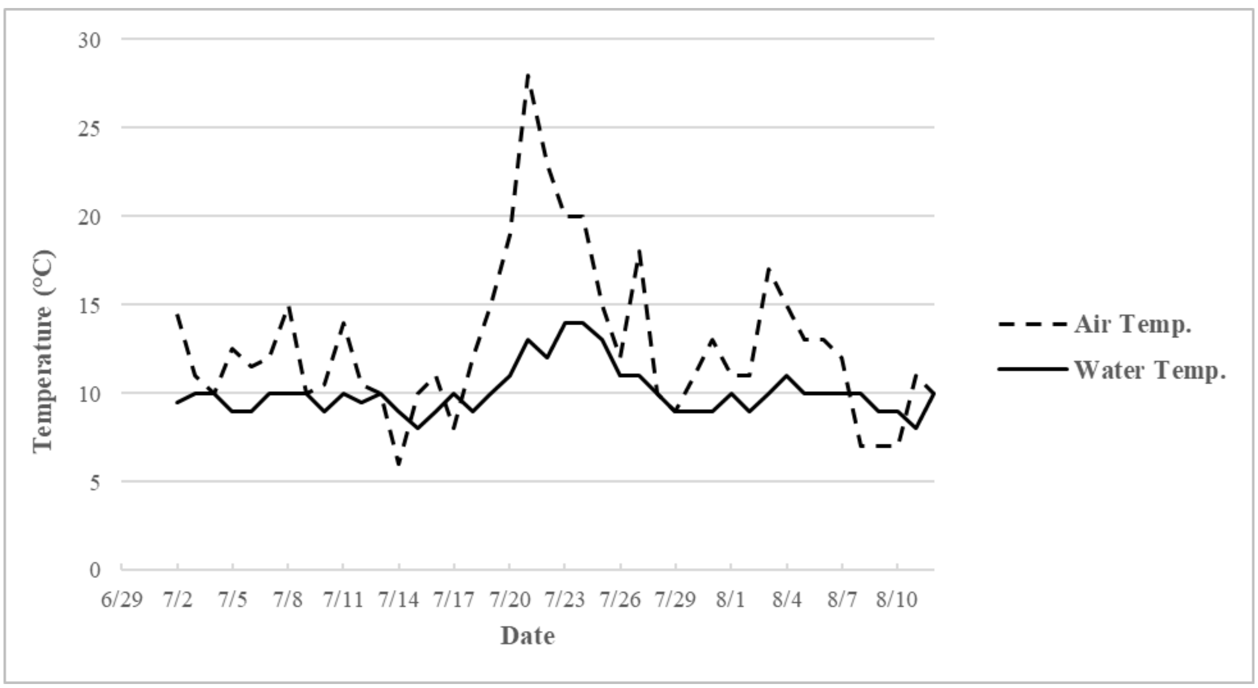


Figure 5. Daily river stage measurements (cm) taken at the Koktuli weir, 2024.

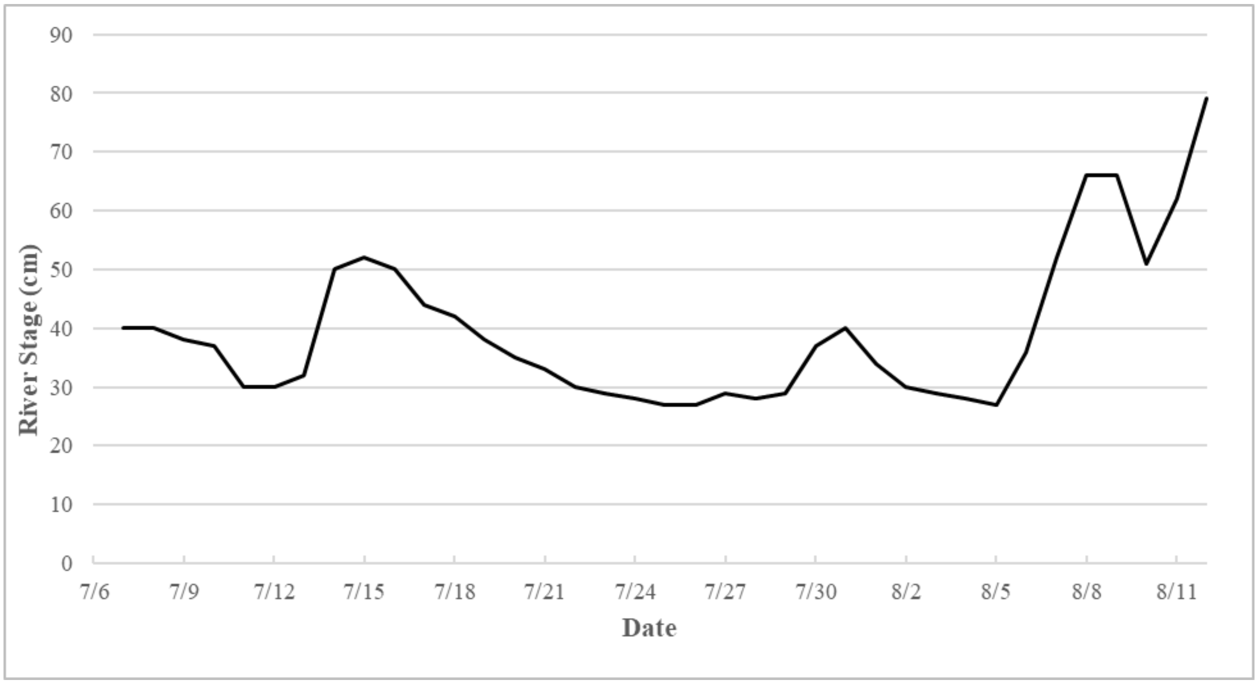


Figure 6. Ambient air and surface water temperatures (℃) taken at the Koktuli weir, 2024.

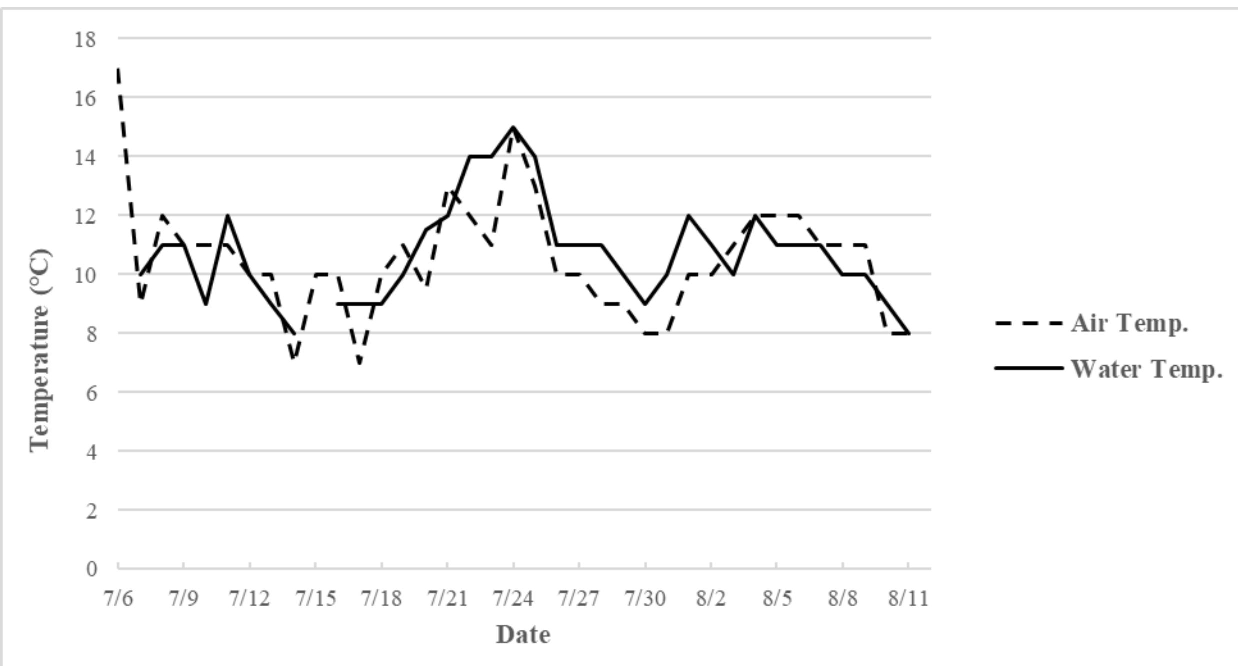


Figure 7. Daily Chinook salmon passage counts from the Upper Nushagak and Koktuli weirs, 2024.

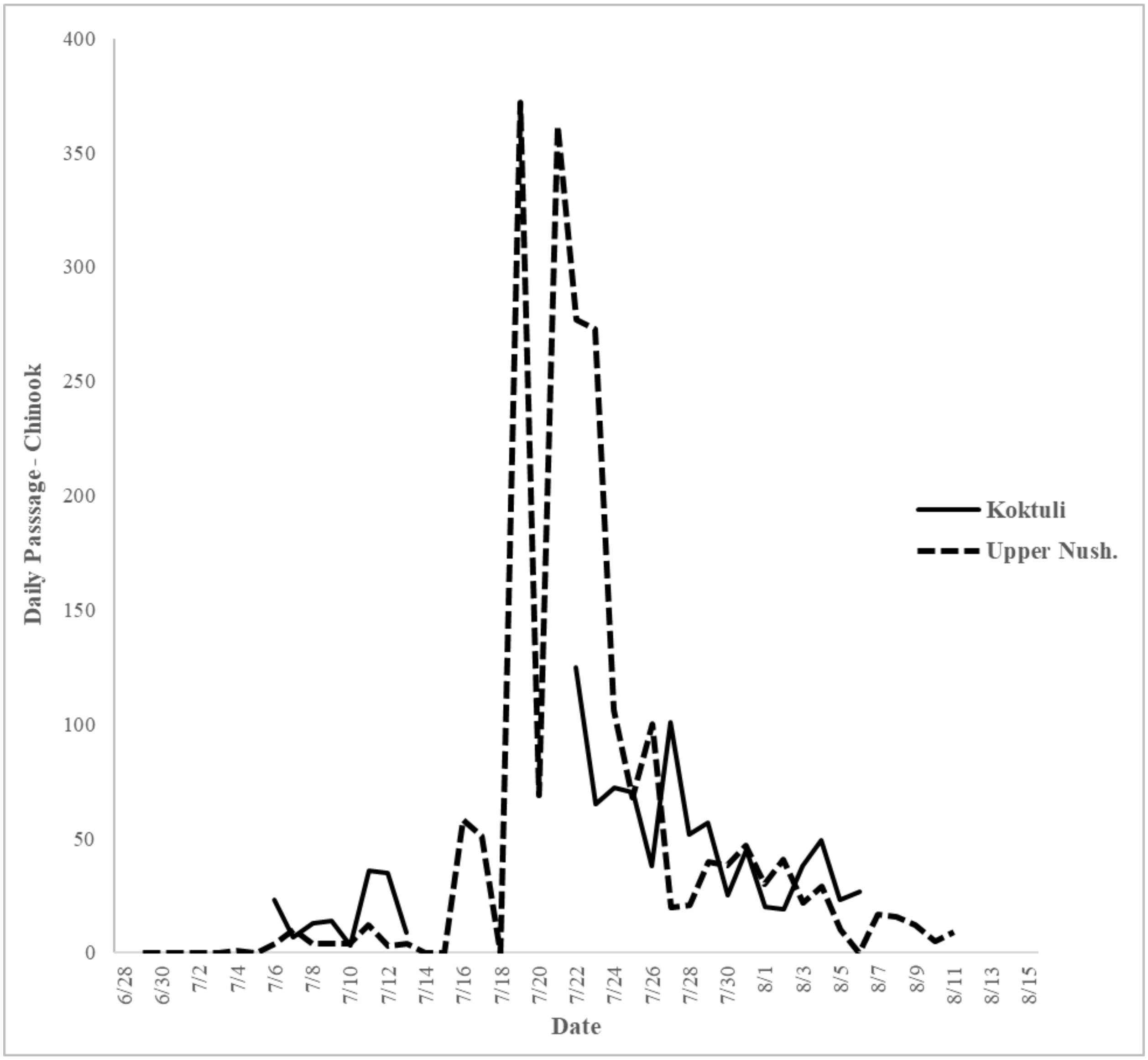


Figure 8. Daily chum salmon passage counts from the Upper Nushagak and Koktuli weirs, 2024.

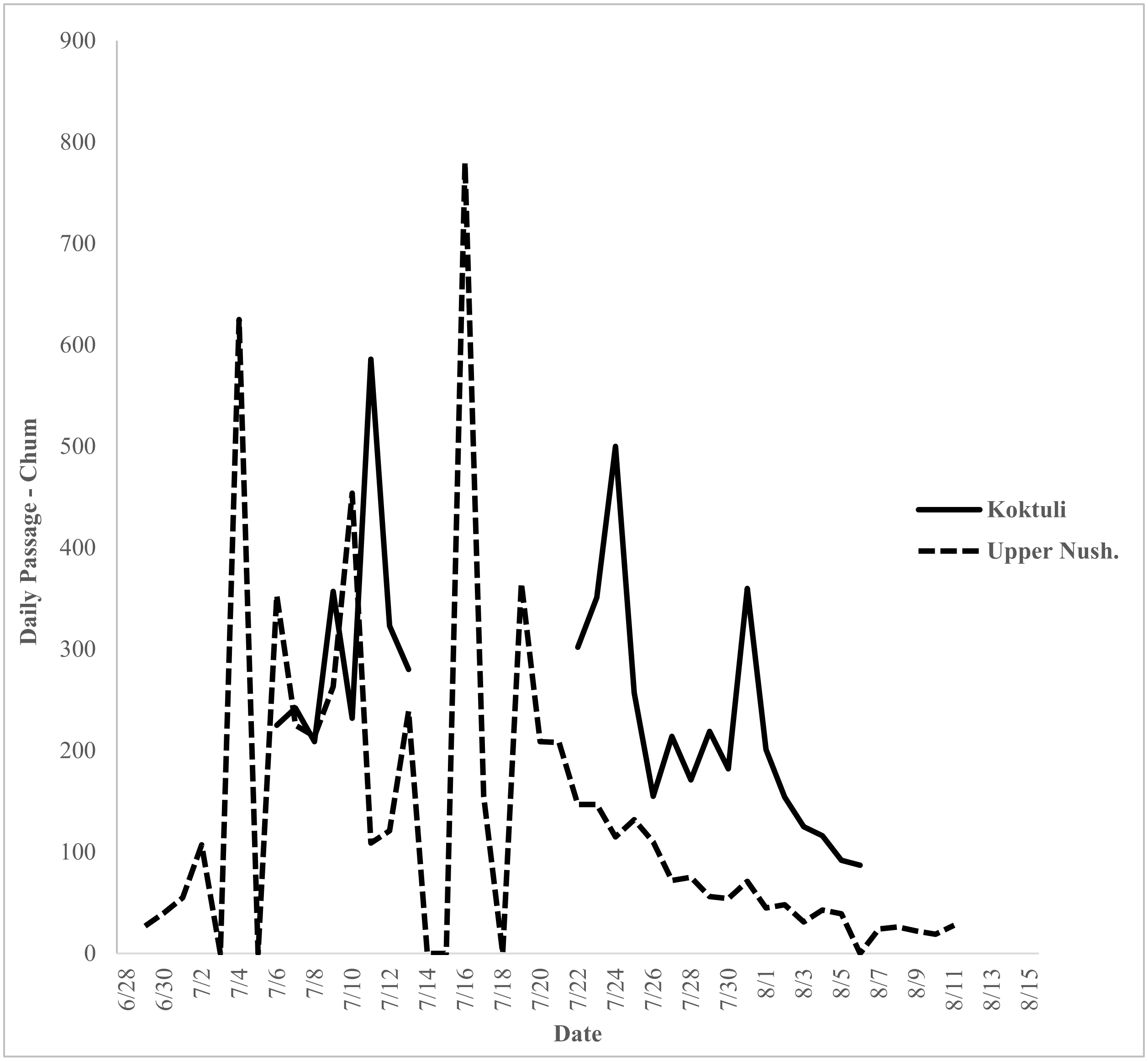
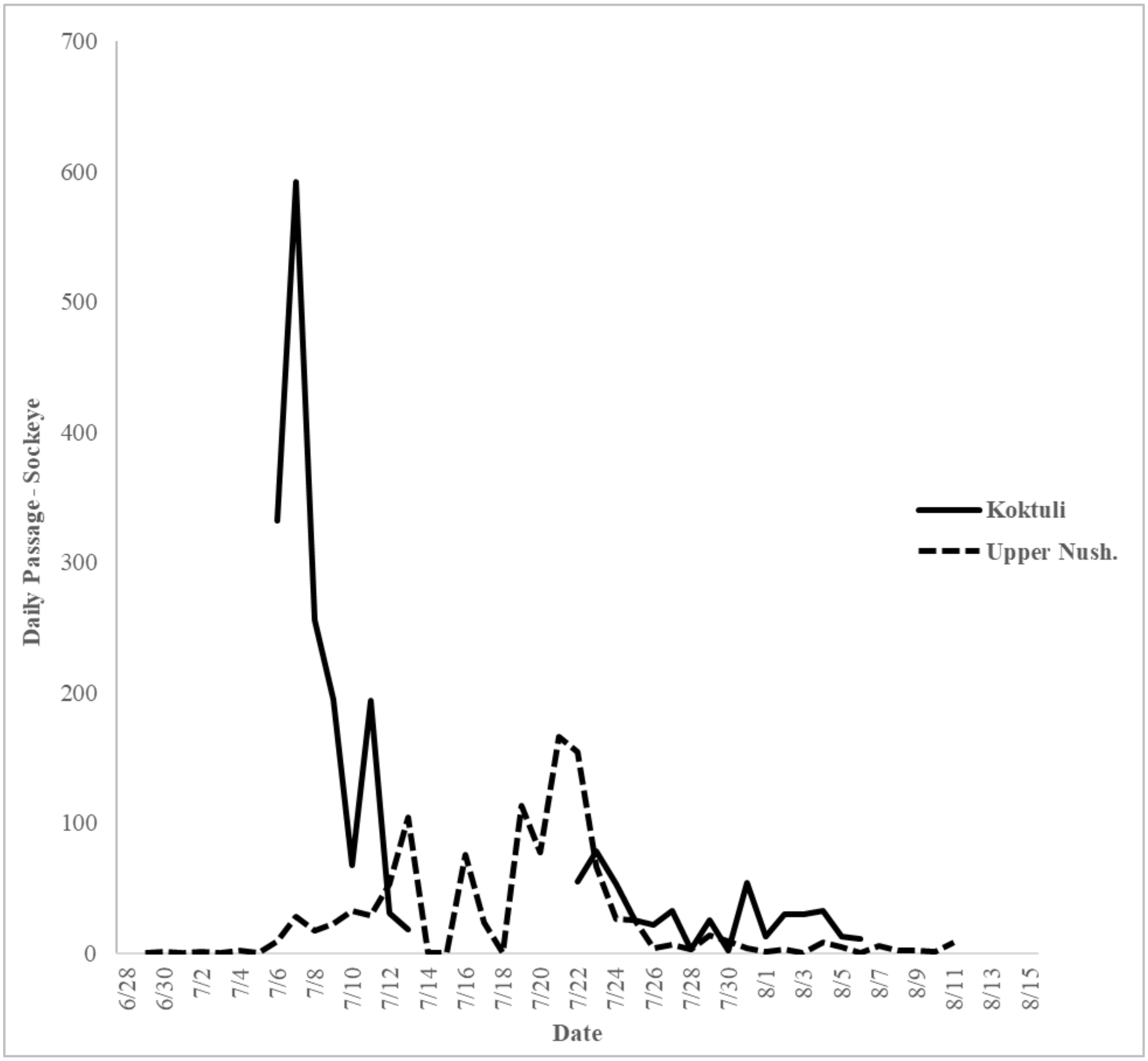
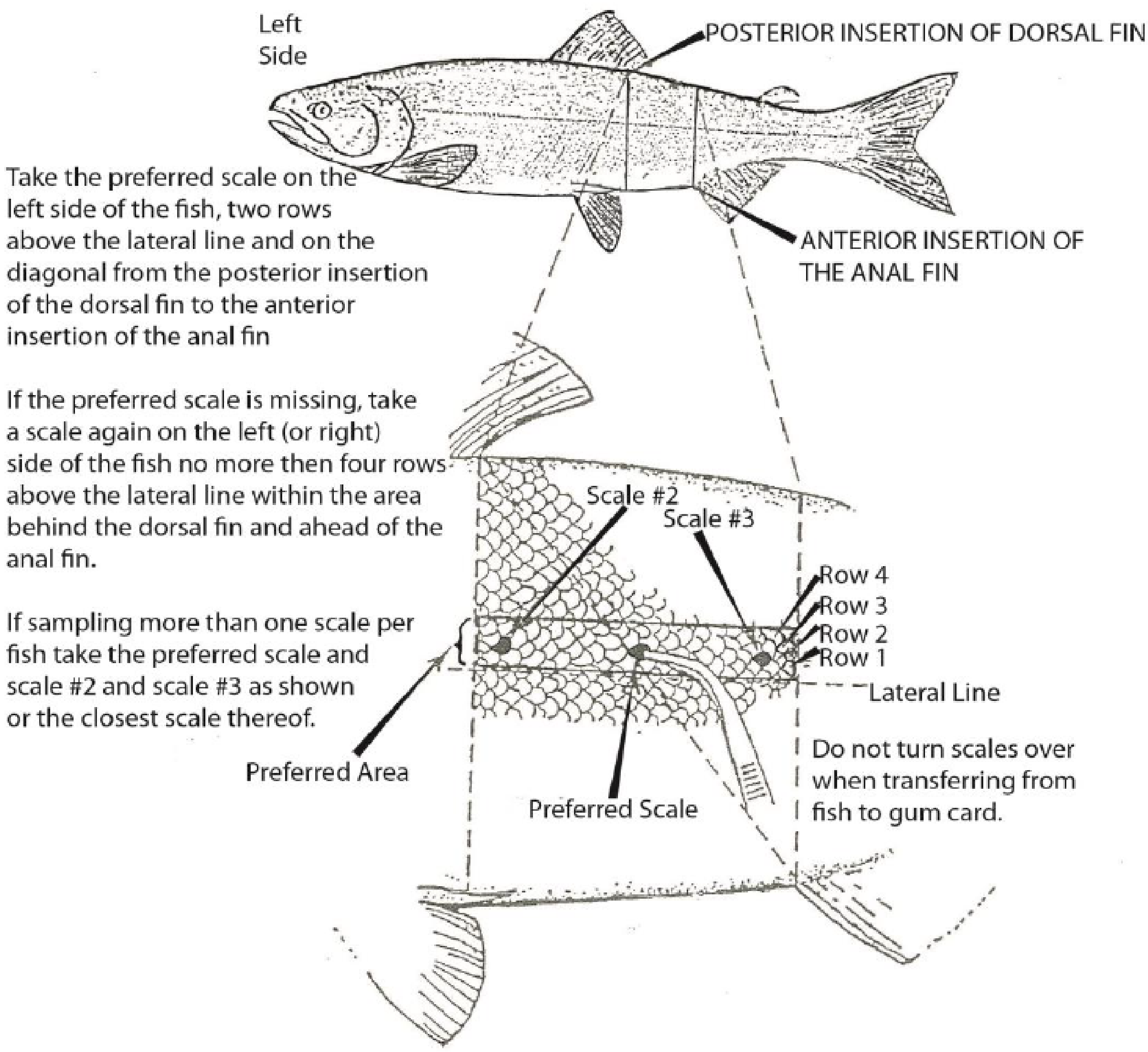


Figure 9. Daily sockeye salmon passage counts from the Upper Nushagak and Koktuli weirs, 2024.



Appendix A – Sampling Protocols

Appendix A1. Protocol for salmon scale sampling (ADF&G 2025c).



Appendix A2, p1. Protocol for fin tissue sampling for genetic analysis (ADF&G Reg II, 2024).

Adult Salmon Fin Tissue Sampling for Genetic Analysis

GENE CONSERVATION LABORATORY
Alaska Department of Fish & Game

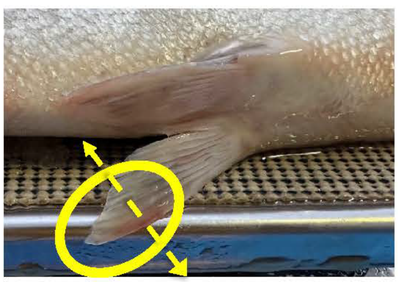
General Information: We use fin tissues as a source of DNA to genotype fish for genetic projects. The genotyped fish are used to determine the genetic characteristics of fish stocks or stock compositions of fishery mixtures. The most important thing to remember in collecting samples is that only quality tissue samples give quality results. Preserving the tissues quickly is essential for obtaining high-quality tissue and is achieved through the following preservation method.

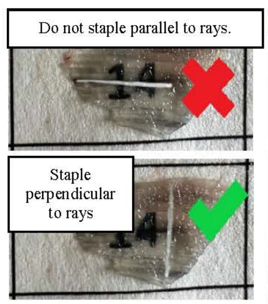
Preservation Method: Fin tissues are preserved on Whatman Genetic Cards (WGCs), which come in 3 sizes (10, 40, and 48 grids, to match different scale cards and sampling rates), Sampling methods and kit supplies are the same for all WGC sizes. WGCs, blotter paper, and silica desiccant bead packets draw water from the tissue samples, which dries and preserves tissues for later DNA extraction. Used desiccant packs must be dried in a warm space (e.g., engine room or dehydrator) before re-use at: 80°F – 100°F (27°C -38°C) for at least 48 hours or 120°F – 160°F (50°C – 70°C) for at least 24 hours.

Prior to sampling: Set up your workspace, fill out the required sample collection information in the header of the WGC, fold back the landscape cloth, and place WGC on the clipboard. You are ready to sample!

Method

Fin clipping example: cut small clip of pelvic fin ½-1" max, dashed line, no larger than what will fit in the grid space on the WGC.





Step-by-step guide to sampling:

1) Wipe fin prior to sampling.
2) Using Fiskars scissors, cut one fin clip per fish.
3) Quickly wipe or rinse scissors between samples to reduce cross contamination.
4) Place one clipped fin tissue onto the # 1 grid space. If large tissue sample, center tissue diagonally on grid space.
5) Staple the sample to the card with staple perpendicular to fin rays.
   - If stapling is not practical during sampling, fins can be stapled afterwards.
6) Repeat steps 4 and 5, following the numerical order printed on the WGC (i.e., 1,2,3,4…).
   - Place only one fin clip per fish into each numbered grid space.
   - Do not overlap fin samples.
7) When WGC is full or sampling is complete, unfold the landscape cloth so it lies over the samples for protection.

Step-by-step guide to loading the Pelican cases – see reverse side.

- Be sure to remove plastic vacuum wrapping before using desiccant pack.
- Close and secure the lid after each WGC is added so drying begins as soon as possible.
- All WGCs must remain in Pelican case at least overnight (normally 12-24 hours) to dry WGCs flat.

Post-sampling storage: All WGCs with tissue samples must remain inside of a Pelican case or plastic file box, if provided, with desiccant packs. Two desiccant packs are allocated for post-sampling storage.

Sample Shipment: Depending on your project, samples will be shipped back to GCL either in the pelican cases or in photo sleeves. If you have photo sleeves, verify all samples are completely dry prior to moving to photo sleeves. The 10WGC photo sleeves can hold 10 cards per page, back-to-back while the 40/48WGC photo sleeves can hold 2 cards per page with backing folded back. If you are unsure of proper sampling or shipping methods for your project, contact your field supervisor or the GCL contact below.

Return Address:
ADF&G GCL
Attn: Heather Hoyt
333 Raspberry Road
Anchorage AK 99518

Questions?
Heather Hoyt (she/her)
Laboratory Archives & Sampling Logistics
Email: heather.hoyt@alaska.gov
Phone: 907.267.2175

version: 06/27/2023

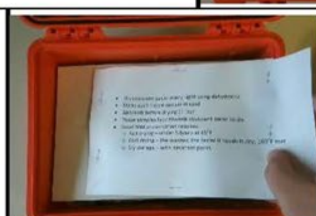
Appendix A2, p2. Protocol for fin tissue sampling for genetic analysis (ADF&G Reg II, 2024).

WGC Drying Protocol

<table>
<tr><th></th><th>WGC40/WGC48</th><th>WGC10</th></tr>
<tr><td>Step 1:

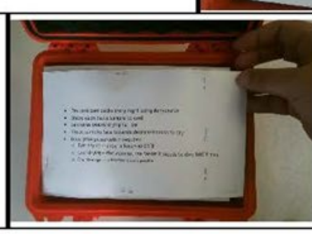
To dry samples, place the first WGC layer face up on the foam insert: up to 3 WGC10s (do not overlap tissues) or 1 WGC40/ WGC48.</td><td></td><td></td></tr>
<tr><td>Step 2:

Place blotter paper down, then a desiccant pack, followed by another blotter paper.</td><td colspan="2"></td></tr>
<tr><td>Step 3:

Place the second WGC layer face down, with the black “rainfly” cover touching the blotter paper.</td><td></td><td></td></tr>
<tr><td>Step 4:

Place third WGC layer face up.</td><td></td><td></td></tr>
<tr><td>Step 5:

Place blotter paper down followed by a desiccant pack and another blotter paper.</td><td colspan="2"></td></tr>
<tr><td>Step 6:

Place the last WGC layer face down onto blotter paper and close pelican case.</td><td></td><td></td></tr>
</table>

Appendix B – Weir Weather Logs

Appendix B1, p1. Upper Nushagak weir daily weather logs, 2024.

Date	Time	Sky Conditions	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity
6/29	8:00	Cloudy	-	-	-	-	-
	19:00	Cloudy	-	-	-	-	-
6/30	8:00	Partly Cloudy	-	-	-	-	-
	18:00	Cloudy	-	-	-	-	-
7/1	8:00	Cloudy	-	-	-	-	-
	17:00	Cloudy	-	-	-	-	-
7/2	8:15	Partly Cloudy	0	14.5	9.5	72	1
	18:30	Partly Cloudy	0	20	10.2	70	1
7/3	9:00	Clear	0	11	10	69	1
	16:00	Partly Cloudy	0	23.5	12	67	1
7/4	9:00	Overcast	0	10	10	67	1
	17:30	Overcast	9.5	11	10	65	1
7/5	10:30	Overcast	0.25	12.5	9	67	1
	17:00	Overcast	0	16	9.5	69	1
7/6	7:50	Overcast	0	11.5	9	67	1
	19:00	Overcast	0	15	10.5	68	1
7/7	10:56	Overcast	0	12	10	61	1
	16:30	Partly Cloudy	0	20	10	61	1
7/8	10:00	Overcast	0	15	10	60	1
	21:00	Overcast	0	15.5	10.5	60	1
7/9	11:00	Overcast	0	10	10	59	1
	16:50	Overcast	4	13	10	59	1
7/10	10:00	Overcast	10.5	10.5	9	59	1
	20:00	Overcast	0	15	10	59	1
7/11	11:20	Overcast	0	14	10	59	1
	17:45	Overcast	0	14	10	59	1
7/12	11:00	Overcast	6.5	10.5	9.5	56	1
	18:00	Overcast	10	10	9	57	1
7/13	10:36	Overcast	7	10	10	60	1
	19:30	Overcast	20	9.5	9.5	62	1
7/14	10:00	Overcast	1	6	9	68	1
	20:00	Overcast	0.5	13	9	73	1
7/15	10:45	Overcast	0	10	8	70	1
	20:00	Overcast	0.1	13	9	70	1
7/16	11:00	Overcast	0	11	9	70	1
	0:00	Overcast	0	8	9	68	1
7/17	9:43	Overcast	1.5	8	10	67	1
	18:00	Partly Cloudy	2.5	14	10	65	1
7/18	9:30	Partly Cloudy	1	12	9	65	1
	23:20	Cloudy	0	11	10	62	1
7/19	10:00	Clear	0	15	10	63	1
	22:30	Clear	0	11.5	12	62	1
7/20	11:00	Clear	0	19	11	62	1
	22:00	Clear	0	11	10	62	1
7/21	12:30	Clear	0	28	13	60	1
	22:00	Clear	0	18	13	59	1
7/22	11:00	Clear	0	23	12	59	1
	0:00	Clear	0	13	14	59	1
7/23	10:40	Clear	0	20	14	58	1
	23:30	Clear	0	18	15	58	1

Appendix B1, p2. Upper Nushagak weir daily weather logs, 2024.

Date	Time	Sky Conditions	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity
7/24	11:00	Clear	0	20	14	58	1
	20:30	Clear	0	26	16	58	1
7/25	10:00	Overcast	0	15	13	57	1
	23:00	Overcast	7.5	12	13	58	1
7/26	10:00	Overcast	1	12	11	60	1
	23:30	Overcast	4	10	11	62	1
7/27	12:00	Partly Cloudy	0	18	11	61	1
	17:00	Partly Cloudy	0	24	17.5	62	1
7/28	11:00	Overcast	2	10	10	61	1
	19:00	Overcast	3	13	10	61	1
7/29	10:30	Overcast	1	9	9	61	1
	17:30	Partly Cloudy	3.5	14	10	63	1
7/30	11:00	Overcast	3.5	11	9	65	1
	17:00	Partly Cloudy	0.5	22	11	63	1
7/31	10:00	Clear	0	13	9	63	1
	18:30	Clear	0	20	12	61	1
8/1	10:00	Overcast	0	11	10	60	1
	21:00	Overcast	0	12	11	59	1
8/2	10:20	Overcast	0	11	9	59	1
	0:30	Overcast	0	10	9	58	1
8/3	12:00	Partly Cloudy	0	17	10	58	1
	20:00	Clear	0	20	13	57	1
8/4	11:15	Overcast	0	15	11	58	1
	19:00	Overcast	0.5	14	11	57	1
8/5	8:30	Overcast	1.5	13	10	57	1
	19:30	Cloudy	18	16	12	58	1
8/6	9:25	Overcast	3.5	13	10	62	1
	19:30	Overcast	1.5	12.5	11	67	1
8/7	9:30	Overcast	11	12	10	75	1
	19:30	Cloudy	0	10	10	79	1
8/8	9:00	Overcast	0	7	10	80	1
	19:30	Clear	0	15	10	80	1
8/9	9:30	Overcast	2	7	9	79	1
	19:30	Overcast	0	11	10	77	1
8/10	9:30	Overcast	7	7	9	75	1
	19:30	Overcast	17	10	9	78	1
8/11	9:30	Overcast	6.5	11	8	85	1
	20:30	Partly Cloudy	0.5	14	10	94	1
8/12	9:30	Overcast	8	10	10	100 +	2
	21:15	Clear	0	9	10	100 +	2
8/13	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
8/14	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
8/15	-	-	-	-	-	-	-
	-	-	-	-	-	-	-

Appendix B2, p1. Koktuli weir daily weather logs, 2024.

Date	Time	Sky Conditions	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity
6/29	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
6/30	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
7/1	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
7/2	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
7/3	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
7/4	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
7/5	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
7/6	7:50	Overcast	0	17	-	-	1
	19:00	Overcast	0	13	-	40	1
7/7	8:00	Partly Cloudy	0	9	10	40	1
	18:00	Overcast	0	17	12	40	1
7/8	8:00	Partly Cloudy	0	12	11	40	1
	17:00	Overcast	0	16	15	39	1
7/9	7:20	Overcast	0	11	11	38	1
	17:15	Overcast	0	13	11	38	1
7/10	8:00	Overcast	0	11	9	37	1
	23:00	Partly Cloudy	0	11	12	30	1
7/11	9:25	Partly Cloudy	0	11	12	30	1
	19:11	Overcast	0	13	11	30	1
7/12	8:30	Overcast	0.5	10	10	30	1
	18:00	Overcast	5	9	10	30	1
7/13	8:00	Overcast	0.25	10	9	32	1
	18:20	Overcast	10	10	10	40	2
7/14	10:30	Overcast	1.5	7	8	50	2
	20:00	Overcast	4.5	10	-	50	2
7/15	10:50	Overcast	0.25	10	-	52	2
	18:00	Overcast	0.5	10	10	52	2
7/16	11:00	Overcast	0.75	10	9	50	2
	19:00	Overcast	0	11	10	48	2
7/17	9:00	Overcast	2.5	7	9	44	2
	18:30	Overcast	1	11	9	44	2
7/18	8:30	Overcast	0	10	9	42	2
	6:00	Partly Cloudy	0	19	11	41	1
7/19	9:00	Partly Cloudy	0	11	10	38	1
	23:00	Clear	0	15	14	37	1
7/20	8:30	Clear	0	9.5	11.5	35	1
	17:05	Clear	0	28	16	34	1
7/21	8:20	Clear	0	13	12	33	1
	19:52	Clear	0	31	17	31	1
7/22	8:00	Clear	0	12	14	30	1
	21:00	Clear	0	29	17	30	1
7/23	8:10	Clear	0	11	14	29	1
	19:00	Clear	0	28	18	29	1

Appendix B2, p2. Koktuli weir daily weather logs, 2024.

Date	Time	Sky Conditions	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity
7/24	8:00	Clear	0	15	15	28	1
	20:51	Clear	0	23	17	27	1
7/25	8:00	Overcast	0	13	14	27	1
	19:30	Overcast	0	13	13	26	1
7/26	8:30	Partly Cloudy	0	10	11	27	1
	18:52	Partly Cloudy	0.1	16	14	28	1
7/27	9:00	Overcast	0	10	11	29	1
	21:00	Partly Cloudy	0	14	11	29	1
7/28	8:30	Overcast	0.25	9	11	28	1
	19:30	Overcast	2.75	12	11	29	1
7/29	9:00	Overcast	0.75	9	10	29	1
	18:30	Overcast	2.55	10	10	30.5	1
7/30	8:15	Overcast	3	8	9	37	1.5
	21:30	Partly Cloudy	0	15	12	42	2
7/31	8:00	Partly Cloudy	0	8	10	40	1.5
	18:50	Partly Cloudy	0	21	13	37	1.5
8/1	8:00	Overcast	0	10	12	34	1
	21:30	Overcast	0	13	13	32	1
8/2	8:00	Overcast	0	10	11	30	1
	15:00	Overcast	0	13	12	30	1
8/3	8:15	-	0	11	10	29	1
	20:00	Partly Cloudy	0	13	14	29	1
8/4	8:00	Partly Cloudy	0	12	12	28	1
	19:40	Overcast	0	14	12	28	1
8/5	8:30	Overcast	3	12	11	27	1
	20:00	Overcast	7.5	13.5	11	30	1
8/6	8:10	Overcast	4.75	12	11	36	1
	19:00	Overcast	5	13	12	48	3
8/7	14:00	Overcast	6.5	11	11	52	3
	-	-	-	-	-	-	-
8/8	10:00	Overcast	3	11	10	66	3
	14:00	Overcast	0.5	17	11	70	3
8/9	9:00	Overcast	3	11	10	66	3
	17:40	Overcast	0	17	11	66	3
8/10	8:40	Overcast	4.5	8	9	51	2
	22:00	Overcast	13.5	9	9	52	2
8/11	8:40	Overcast	1.75	8	8	62	3
	20:00	Overcast	0.75	15	11	71	3
8/12	10:40	Overcast	-	-	-	79	-
	-	-	-	-	-	-	-
8/13	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
8/14	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
8/15	-	-	-	-	-	-	-
	-	-	-	-	-	-	-

Appendix C – Weir Passage Counts

Appendix C1. Upper Nushagak weir nontarget species passage counts, 2024.

Date	Pink	Coho	Dolly Varden	Whitefish
6/28 [a]	N/D	N/D	N/D	N/D
6/29	0	0	0	0
6/30	0	0	0	0
7/1	0	0	0	0
7/2	0	0	0	0
7/3 [a]	0 [b]	0 [b]	0 [b]	0 [b]
7/4	0	0	0	0
7/5 [a]	0 [b]	0 [b]	0 [b]	0 [b]
7/6	0	0	0	0
7/7	0	0	0	0
7/8	0	0	0	0
7/9	0	0	0	0
7/10	0	0	0	0
7/11	0	0	0	0
7/12	0	0	0	0
7/13	0	0	0	0
7/14 [a]	0 [b]	0 [b]	0 [b]	0 [b]
7/15 [a]	0 [b]	0 [b]	0 [b]	0 [b]
7/16	0	0	0	0
7/17	0	0	0	0
7/18 [a]	0 [b]	0 [b]	0 [b]	0 [b]
7/19	0	0	0	0
7/20	0	0	3	0
7/21	1	0	5	0
7/22	0	0	0	0
7/23	0	0	0	0
7/24	0	0	2	0
7/25	0	0	3	0
7/26	0	0	2	0
7/27	0	0	0	0
7/28	0	0	0	0
7/29	0	0	0	0
7/30	0	0	0	0
7/31	0	0	0	0
8/1	0	0	0	0
8/2	0	0	0	0
8/3	0	0	0	0
8/4	0	0	0	0
8/5	0	0	0	0
8/6 [a]	0 [b]	0 [b]	1 [b]	0 [b]
8/7	0	0	0	0
8/8	0	0	0	0
8/9	0	0	2	0
8/10	0	0	1	0
8/11	0	3	1	0
8/12 [a]	N/D	N/D	N/D	N/D
8/13 [a]	N/D	N/D	N/D	N/D
8/14 [a]	N/D	N/D	N/D	N/D
8/15 [a]	N/D	N/D	N/D	N/D
Total	1	3	20	0

[a] Weir inoperable for all or part of day

[b] Partial or incomplete count

Appendix C2. Koktuli weir nontarget species passage counts, 2024.

Date	Pink	Coho	Dolly Varden	Whitefish
6/28 [a]	N/D	N/D	N/D	N/D
6/29 [a]	N/D	N/D	N/D	N/D
6/30 [a]	N/D	N/D	N/D	N/D
7/1 [a]	N/D	N/D	N/D	N/D
7/2 [a]	N/D	N/D	N/D	N/D
7/3 [a]	N/D	N/D	N/D	N/D
7/4 [a]	N/D	N/D	N/D	N/D
7/5 [a]	N/D	N/D	N/D	N/D
7/6	0	0	0	0
7/7 [a]	0 [b]	0 [b]	0 [b]	0 [b]
7/8 [a]	0 [b]	0 [b]	0 [b]	0 [b]
7/9	0	0	0	0
7/10	0	0	0	0
7/11	0	0	0	0
7/12	0	0	0	0
7/13	0	0	0	0
7/14 [a]	N/D	N/D	N/D	N/D
7/15 [a]	N/D	N/D	N/D	N/D
7/16 [a]	N/D	N/D	N/D	N/D
7/17 [a]	N/D	N/D	N/D	N/D
7/18 [a]	N/D	N/D	N/D	N/D
7/19 [a]	N/D	N/D	N/D	N/D
7/20 [a]	N/D	N/D	N/D	N/D
7/21 [a]	N/D	N/D	N/D	N/D
7/22	0	0	0	0
7/23	0	0	6	0
7/24	0	0	11	0
7/25	0	0	5	0
7/26	0	0	4	0
7/27	0	0	4	0
7/28	0	0	0	0
7/29	1	0	6	0
7/30	0	0	0	0
7/31	0	0	1	0
8/1	0	0	3	0
8/2	1	0	4	0
8/3 [a]	0 [b]	0 [b]	1 [b]	0 [b]
8/4	0	0	2	0
8/5	0	0	1	0
8/6 [a]	0 [b]	0 [b]	2 [b]	0 [b]
8/7	N/D	N/D	N/D	N/D
8/8	N/D	N/D	N/D	N/D
8/9	N/D	N/D	N/D	N/D
8/10	N/D	N/D	N/D	N/D
8/11	N/D	N/D	N/D	N/D
8/12	N/D	N/D	N/D	N/D
8/13	N/D	N/D	N/D	N/D
8/14	N/D	N/D	N/D	N/D
8/15	N/D	N/D	N/D	N/D
Total	2	0	50	0

[a] Weir inoperable for all or part of day

[b] Partial or incomplete count

Photos

Photo 1. Technician sampling Chinook salmon at the Koktuli weir, July 2024.

Photo 2. Koktuli weir, July 2024.

Photo 3. Overhead view of the Koktuli weir, showing livetrap (left) and floating panel boat gate (right), July 2024.

Photo 4. Weir and camp materials being transferred from Lifeline Logistics barge at the mouth of the Mulchatna River, June 2024.